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contents

THE NEW SWEDISH NATIONAL FOREST SURVEY 3
Erik Hagberg

SHIFTING CULTIVATION 9
FAO Staff

EROSION AND A REMEDY 12
FAO Staff

REGIONAL CLIMATES AND VEGETATION 14
Sir Harry Champion and N. V. Brasnett

CONTROL OF BRUSH AND UNDESIRABLE TREES: IV 19
Arthur W. Sampson and Arnold M. Schultz

COMMODITY REPORT 26
China's Rising Paper Output

THE WORK OF FAO 29
Silviculture Study Tour in Czechoslovakia 29
Watershed Management in Yugoslavia 29
ECE Timber Committee 30
World Eucalyptus Conference 30
Shelterbelt and Arid-Zone Forestry in the U.S.S.R. 31

EQUIPMENT SECTION 33

NEWS OF THE WORLD 36

BOOK NOTICES 47

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Cover Photograph: *After the Twelfth Congress of the International Union of Forest Research Organizations in 1956, members visited various parts of Britain to see the progress made in establishing Britain's new forests. This photograph, of a young man setting out to plant spruce trees at Fetteresso Forest, in Scotland, seems to typify the spirit of quiet determination with which the planting program is being carried out.*

Photograph: U.K. Forestry Commission

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An International Review of Forestry and Forest Products

A NECESSARY ADJUNCT TO PLANTING PROGRAMS

It is a very natural and common reaction to decide that, if a timber does not behave satisfactorily with a conventional practice which gives excellent results with other timbers, the timber is at fault and is useless for the purpose intended.

This was the initial attitude towards eucalypts in Australia where at one time only those species which gave little trouble (if the usual utilization practices were carried out) were used. The remainder of the eucalypts were ignored or classed as suitable only for such low-grade purposes as firewood, and the balance of the timber requirements of the country were imported.

This remained the position until the Commonwealth Scientific and Industrial Research Organization in Australia set up a Division of Forest Products nearly 30 years ago. At that time Australia's sawn timber consumption was about 1,000 million superficial feet (1 sup. ft. = 2.36 m^3), but only half of this was produced locally, the balance being imported. Today, the consumption of local timbers is about three times as great and imports have declined to about two-thirds of their former extent. In spite of the fact that the more favored and readily available eucalypt resources have been reduced, the percentage of eucalypts in present total production has been increased to about 80 percent. Further, any eucalypts which were at one time regarded with disfavor are now preferred for a number of exacting uses in which imported timbers are now only accepted where there is a local deficiency of supply. For example, in Melbourne, 90 percent of the flooring requirements were formerly imported from Scandinavia, whereas today eucalypts are almost entirely used.

This vast change has been brought about by a thorough study of the characteristics of Australian timbers. Their disabilities have been overcome by the development of suitable practices for sawing, grading, seasoning, preservation, and so forth.

Much of the information and experience so gained is of value in assisting the utilization of plantation-grown eucalypts in other countries. But it must be recognized that under plantation conditions new difficult characteristics may become present, and undesirable features may be much exaggerated. Nevertheless, it is certain that further investigation can result in the development of suitable utilization practices.

The first requirement is an appreciation of the growth characteristics and of the properties of the wood produced under "exotic" conditions.

This was brought out during the discussions at the recent World Eucalyptus Conference organized by FAO at Rome, and which is reported on later in this issue. These discussions covered a wide field in utilization and dealt with subjects of interest to many countries, including wood used in round and sawn form, as well as pulpwood and charcoal. The feeling was that, if countries are prepared to spend large sums of money on the establishment of eucalypt plantations, they should be prepared to engage on utilization research. And not only laboratory research but also time studies on logging and other field operations, such as have already been initiated in Italy. Tanganyika was mentioned as a country where a special utilization section on eucalypts had been set up. Although only recently in operation, the section comprises a sawmill, woodworking and wood-testing machinery, seasoning kilns, and a pressure impregnation plant.

The Conference reviewed other existing activities and the present and likely future problems of countries growing eucalypts. It seemed clear that some countries were well advanced in eucalypts utilization. In others, uses are still restricted to roundwood because of difficulties encountered in sawing and seasoning.

If these difficulties can be overcome, eucalypts could play a much more important part in the economy of many countries.

Some of the problems will have to be studied where the eucalypts are grown. Others will require laboratory and pilot plant facilities. It is essential to avoid overlap and duplication and to make full use of all the testing facilities that exist.

In short, a vigorous program of utilization research should be pursued in all countries as a necessary adjunct to any planting programs of eucalypts or other exotic species. But co-ordination of these research activities is essential, together with the interchange of information to make known the problems which arise. While maximum use should be made of straight correspondence, co-ordination could well be facilitated by FAO through its headquarters and its various services, which already provide a workable machinery. To the extent possible, this will be done.

FIGURE 1. *The national forest survey. The growing stock is determined by measuring the trees on sample plots.*
Photograph: Bombergs Bilder, Stockholm

FIGURE 2. *Sweden produces some 1.5 million standards of sawn wood annually, over 64 percent being of export grades, and Swedish timber is firmly established on world markets.*
Photograph: Swedish Forestry Association

The New Swedish National Forest Survey

Professor Erik Hagberg
Head of the Department of Forest Survey, Forest Research Institute of Sweden

In order to arrive at a correct judgment concerning forestry questions of current interest, a knowledge of the condition of the forests and the changes occurring in them is required. It is the task of the national forest survey to supply the necessary information in this respect. This information includes data concerning the size and composition of the growing stock, the rate of growth and — from the new type of inventory started in 1953 — also the present drain. In addition, the survey gives a land classification including a detailed description of the forest area.

History

The first national forest survey, carried out in 1923-29, was of a pure strip- (or line-) survey type, i. e., the estimates were made within parallel strips 10 meters in width located at fixed distances apart (see Figure 3). The area was registered in meter lengths by continuous linear measurement along the lines, and all trees within the survey strip were recorded and distributed according to species and diameter classes (5-centimeter classes). In order to obtain the factors for computing the volume and the growth, sample trees were selected according to a certain quotient system, and detailed measurements of these trees were then made with regard to their diameter at breast height, bark thickness, height, increment, age, etc.

The second national forest survey was carried out in 1938-52 as a line plot survey along a line system similar to the one employed in the first survey, although the line spacing was somewhat closer. As before, the area was registered by continuous linear measurement along the survey lines. In addition, however, the distribution of the area was also recorded on the sample plots for stocktaking, located at fixed intervals along the lines. Various forms and sizes of sample plots were tested. The most suitable type proved to be circular plots within an area of about 140 square meters. All trees on these plots were recorded according to species and diameter-classes, and sample trees were selected in accordance with a certain system. The sample trees were measured to obtain the factors required for computing the volume (diameter at breast height, bark thickness, tree height, height to lower crown limit); they were bored for age and increment, and the terminal shoots were measured. In northern Sweden (Norrland and Dalecarlia), a complete strip-survey, including a

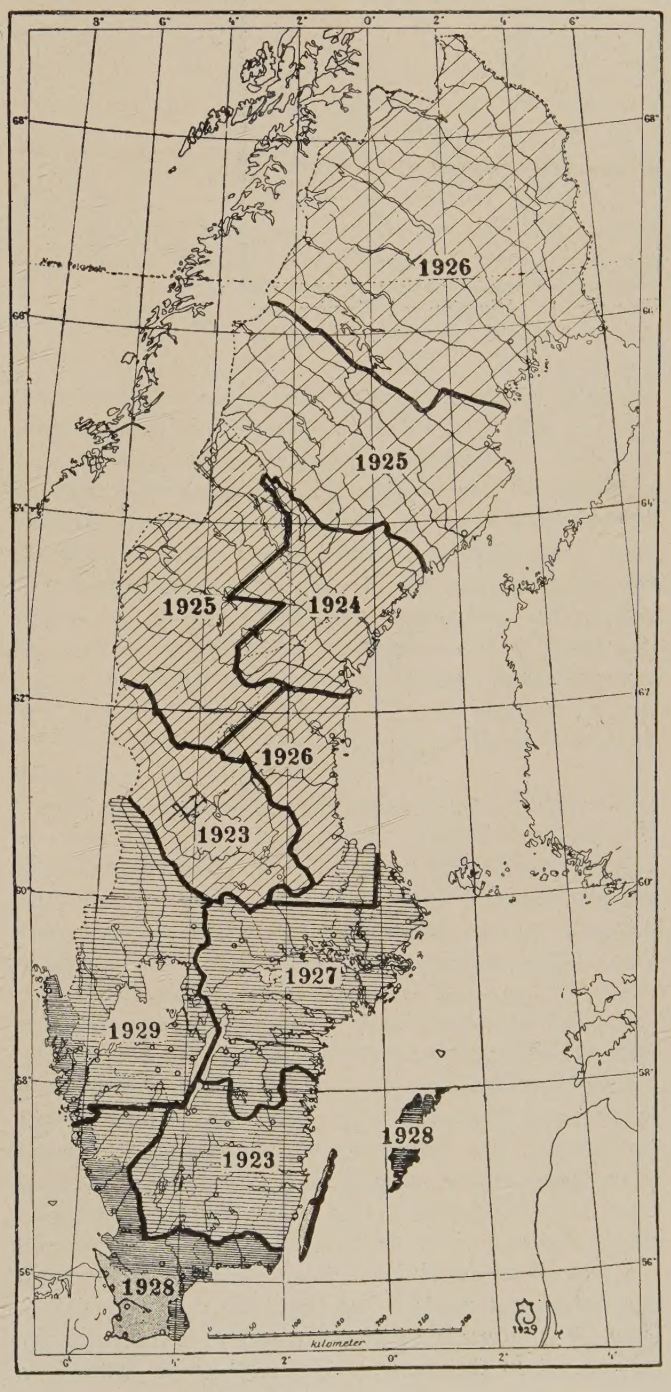


Figure 3. *Map of Sweden showing the survey line system in the first national forest survey in 1923-29.*

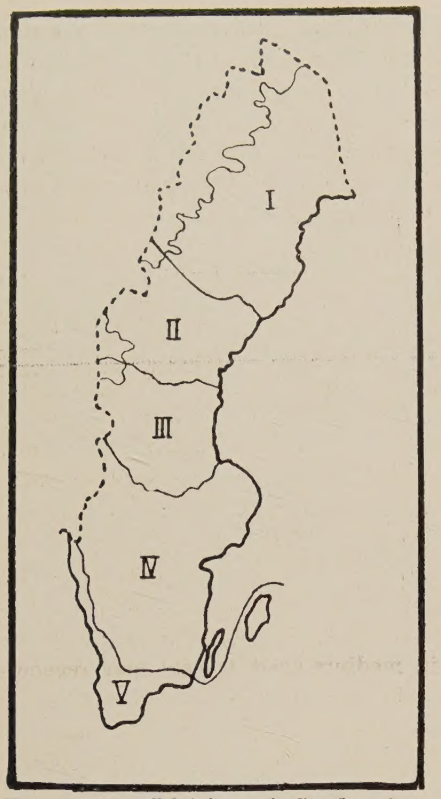
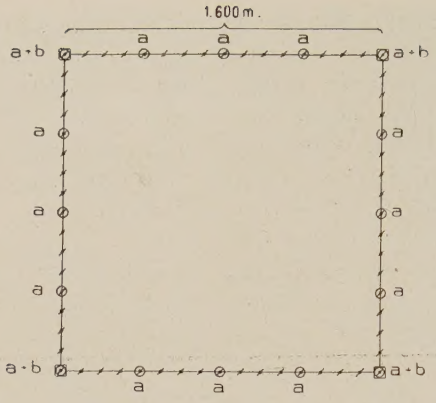


FIGURE 4. *Division of Sweden into regions in the new national forest survey.*



Sample plots for tree tallying, and for measuring basal area and radial increment (16 plots per tract).

Sample plots for measuring height, terminal shoots, etc. (4 plots per tract).

Sample plots for stump enumeration (64 plots per tract).

FIGURE 5. *A survey tract in Region III with sample plots.*

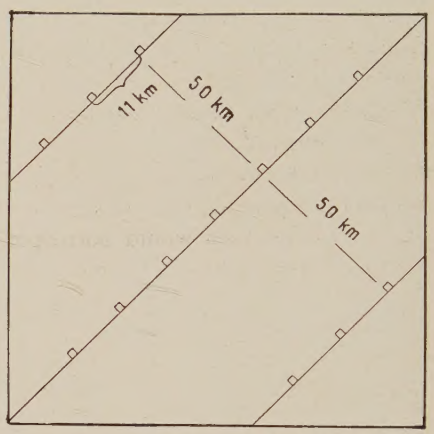


FIGURE 6. *The distribution of one year's survey tracts (Region III).*

tree tally within a 10-meter wide strip, was carried out together with a stock inventory on sample plots in order to obtain material for a comparison between the two methods of survey. This comparison showed that although the percentage of surveyed area was considerably lower, the sample plot method gave a result only slightly less accurate than the strip-survey. Since plot-surveying can be carried out at a much lower cost, this type of survey was subsequently employed exclusively in the surveys of central and southern Sweden.

General Outline

The earlier national forest surveys had been performed as provincial inventories, i. e., one or two provinces were surveyed each year. This method of surveying was accompanied by a serious disadvantage, however, inasmuch as the results for the whole country were partly based on up-to-date figures and parly on figures which were as much as 15 years old. In the new inventory, started in 1953 and planned to be completed in 1962, this disadvantage has been eliminated by adopting a low-percentage inventory which covers the whole of Sweden and is repeated each year; thus after 10 years the country will have been surveyed with the same percentage as that employed in the second national forest survey. Actually, this means that the new inventory includes a whole series of annual national surveys.

A new phase involving cutting statistics in the form of a stump-enumeration has been added to the survey. Thus, it is possible to give an annual account of the volume cut in the same units (forest cubic meters) as the growing stock and the increment and with the same distribution of tree species and diameter classes.

After each annual survey, the new inventory provides reliable data for the whole country and, after two years, figures are obtained for the northern (Regions I-II) and southern (Regions III-V) halves of the country. (With regard to the division of Sweden into regions, see Figure 4). After the third or fourth year, reliable figures can be given for each of the five separate regions, and after ten years, i. e., at the and of the survey cycle, for the different provinces also — Sweden is divided into 24 administrative units, called *län*. The growing stock — and the changes it undergoes — may be followed throughout the whole of Sweden or in parts of the country by the new method in a way that was not possible when using the old methods. Thus, a balanced account may be prepared at intervals of several years — or annually — between the growing stock at the beginning of the interval with the addition of growth and the deduction of fellings on the one hand, and the growing stock at the end of the interval on the other hand.

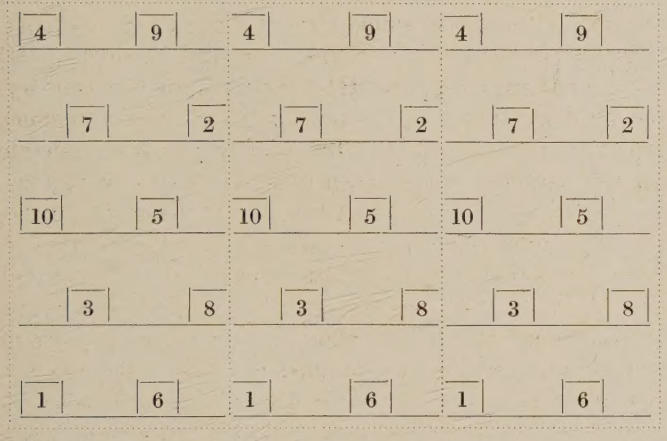
The survey "tracts"

It was intended to carry out the new inventory as a line plot survey on the same fundamental principles as those adopted in the second national forest survey of central and southern Sweden. The system of survey lines employed in the second survey was also used as a basis in planning the new inventory. As described above, each annual survey was intended to cover the whole country and would include one-tenth of the total area surveyed in the previous inventory. This

principle was applied as follows, the sample plots being of the same size and located at approximately the same intervals along the lines as in the previous survey: half the length of every fifth line in the old linear system was to be surveyed each year ($1/2 \times 1/5 = 1/10$). The annual strip along a line to be surveyed in this manner was not measured in one continuous sweep. The whole length of the line was divided into sections of 4.8 to 8.8 kilometers. Every second of these linear sections was surveyed in the course of a year. Each of these sections was called a " survey tract. " Instead of surveying these tracts along a straight line, it was found preferable to carry out the survey along the four sides of a square. In this way, the time wasted during the field work could be considerably reduced, the survey starting and ending at approximately the same point. The total length of the four sides of the square is equal to the length of the corresponding linear section of 4.8 to 8.8 kilometers. The lengths of the sides of the tracts (or squares) were chosen so that the total length of the whole tract would correspond approximately to a day's work, being arranged as follows:

Region	*Kilometers*
I	$4 \times 2.2 = 8.8$
II	$4 \times 1.8 = 7.2$
III	$4 \times 1.6 = 6.4$
IV	$4 \times 1.4 = 5.6$
V	$4 \times 1.2 = 4.8$

The main principle employed in setting out the survey tracts may be seen from the following sketch:



In the sketch, the full lines indicate survey lines, the broken lines showing boundaries of survey districts; within each survey district, the ten annual tracts of the survey cycle ($\boxed{1}$ = tracts to be surveyed during the first year, i. e., in 1953, $\boxed{2}$ = tracts to be surveyed during the second year, i. e., in 1954, etc.) have been grouped along the five survey lines in order to obtain as uniform a spacing of the survey districts as possible after each new annual survey.

As may be seen from the sketch, each survey tract has one of its four sides in common with the corresponding linear strip of the second national forest survey. This fact renders it possible to compare the results of the two surveys, especially with regard to land-use classification (forest land, cultivated land, waste land, etc.). Changes in land classification caused by the conversion of cultivated land into forest land, or of bogs into cultivated or forest land by drainage, may be studied more conveniently by making a repeated inventory of one and the same line section. An entirely accurate comparison is not feasible since it is not possible to follow the survey line strictly in the field.

Area register

The principles adopted for detailed recording in the field are roughly the same as those employed in the second national forest survey. Thus, an area register is made along the survey line, dividing the measured length — in meters — into land-use classes. The forest area is subdivided into different classes such as forest land proper or pasture forest land, ownership groups, site classes (with regard to the yield capacity of the soil), cutting classes (according to the form of felling that should be employed in the various stands such as cleaning in seedling stands, sapling stands or young stands, thinning in medium-aged forests, and regeneration felling in mature forests; denuded forest land is also registered as a special cutting class); in addition reproduction measures recently undertaken are recorded.

The sample plots

The growing stock is estimated on circular sample plots having a radius of 6.64 meters, i. e., with an area of about 138 square meters. There are 4 plots per tract side (in Region V, the number is increased to 7 plots per tract side owing to the comparatively low percentage of forest land in this area). The average interval between the sample plots along the survey line is: for Region I, 550 meters; Region II, 450 meters; Region III, 400 meters; Region IV, 350 meters; Region V, 170 meters. By way of simplification, the plots are laid out in even hundreds of meters, however, and the actual intervals will therefore differ somewhat. Figures 5 and 6, showing a survey tract in Region III, will afford an idea of the location of the sample plots.

On a special sample-plot sheet the land-use class of the sample plot, site conditions such as vegetation, exposure to wind, and slope of the ground are recorded; furthermore, various forestry data already available from the area register sheet are noted, such as ownership, productivity, cutting-class and any reproduction measures undertaken. In addition, the age class, degree of density, general condition of the stand, and a description of the previous development of the stand (origin, previous fellings) are included and forestry measures suggested.

The volume is subsequently obtained by tallying all trees on the plot according to species and 5-centimeter-diameter classes at breast height; this is done on the tree-tally portion of the sample plot sheet.

The sample trees

Sample trees are chosen from among the tallied trees on the plots, according to certain methods. Detailed measurements are made of the factors determining

volume, growth, age and quality. The sample trees are selected on concentric plots, the radius of which varies from 1 meter for the smallest diameter classes to 6.64 meters (= the standard plot radius) for the largest. In Region III, for instance, the sample trees were selected as follows:

Diameter class	Plot	
	Type	Radius, in meters
0 —	circular	1.00
5 —	circular	1.64
10 —	½ – circular	3.29
15 —	½ – circular	4.93
20 +	circular	6.64

The figures for the radius refer to the detachable sections of the 5-meter pole used in measuring the height of the sample trees; the center of the concentric sample tree plots coincides with that for the standard sample plot.

The total number of sample trees was chosen with a view to ensuring the required precision of the results, and the distribution of the total number among the various diameter classes was made in approximate proportion to the mean cubic volume of the respective classes.

As described above, the measurements of the sample trees include the factors determining the cubic volume: diameter at breast height, double bark thickness, tree height and the height to the lower crown limit. By means of these data the cubic volume of each sample tree, inside and outside bark, is computed with the aid of Näslund-Hagberg's volume tables, which are based on Näslund's large volume functions. The cubic volumes of the individual sample trees are then added up for each tree species and diameter class, after which mean cubic volume for the different classes is computed. By multiplying the mean volume by the number of trees tallied in the corresponding diameter class on the sample plots, the cubic volume per hectare is determined, and finally, by multiplying the figures obtained by the area of the district or region in question, the total volume is worked out.

In addition, the sample trees are bored for increment and age. The cores are forwarded to the central bureau in Stockholm, where they are measured in machines specially constructed for measuring annual rings by the Swedish Forest Research Institute. By these measurements the annual diameter growth for the preceding five years is determined; thus the diameter at breast height may be computed for five years preceding the survey. By measuring the diameter growth for each year during this five-year period, data are obtained for calculating the growth variation of different tree species in various regions in relation to average growth studied over a relatively long period. The height growth of the sample trees during the five-year period is estimated by measuring the leading shoots with special field-glasses. When the diameter and height both at the time of the survey and five years earlier are known, the corresponding two volumes of each sample tree may be obtained from the volume tables based on Näslund's small volume functions; the difference between these two cubic volumes is equivalent to the growth of the sample tree during the five-year period. On adding up the growth of the sample trees by species and diameter classes and dividing the resulting sums by the corresponding volumes at the time of the survey, volume growth percentages (discount percentage) are obtained. By applying these percentages to the cubic volume per hectare or to the total volume as computed above, the growth volume during the five-year period investigated may be obtained, excluding the growth of trees felled.

The age of the sample trees (at breast height) is determined by counting the annual rings of the increment cores. The actual age of the tree is then obtained by adding the number of years taken for a tree to attain breast height. The age thus determined is checked against the age-class estimate made in the field.

Finally, the sample trees on the sample plot are also appraised as to quality, i. e., defects are recorded as well as the estimated division of the trees into different assortments of timber (veneer wood, saw timber, pulpwood, joinery wood, fuel wood).

Marking the trees for felling

In connection with the tree enumeration on the sample plots, the crew leader marks, and registers separately, trees which from a purely silvicultural point of view should be cut in the immediate future. This "sample cut" corresponds to the volume which should be felled during a period equivalent to the appropriate interval between thinnings. This interval varies in different parts of the country; the following average figures are given: 20 years in Region I-III, 10 years in Region IV, and six years in Region V. The chief purpose of "sample marking" is to obtain a general conception of the volume to be cut according to a certain silvicultural method regarded as rational. It is employed as a basis for making felling calculations. The marking results may require some modification in the final calculation with regard to a surplus or a deficit of overmature or mature timber, or to the difficulties in carrying out regeneration measures within a reasonable time in stands that should be cut according to the marking.

Stump enumeration

Felling statistics which constitute part of the national forest survey, are obtained in the field in the form of a stump enumeration, and are prepared as follows. At every 100 meters along the survey strip observations are made of fellings undertaken during the last felling season as well as during the last season but one. When making the observations, attention should be directed

to an area within 20 meters from the 100-meter mark; the stump enumeration itself is, however, performed within a circular plot having a radius of 6.64 meters. The fact as to whether fellings of the above kind have been carried out or not is registered at every 100 meters on a special stump enumeration sheet. Where fellings have been made, certain stand characteristics of the plot are recorded (site class, age class, etc.).

In addition, the season must be determined during which cutting has occurred. The beginning of the period of growth each year has been chosen as the boundary between different seasons. Thus, by adopting "vegetation years" instead of calendar years, the distinction between cutting seasons is considerably facilitated. It will now first be necessary to investigate whether cutting was undertaken during the winter or summer. Summer fellings are recognized by the fact that the terminal growth has started, which may be seen from tops and limbs left on the ground.

The beginning of the growing season naturally varies from year to year and from district to district. However, stumps which have not been registered one year will be included in the following year, and the average for several years may therefore be regarded as correct. Owing to the fact that very few fellings are made during the period in question, the number of borderline cases will be very small. The next point consists in distinguishing between the last season's summer fellings and the summer fellings of the last season but one, and also between the winter fellings of the two seasons. This is done chiefly by judging the general appearance of the stump, the color of the needles on tops and branches left on the ground, remnants of sawdust close to the stump, or the occurrence of recently fallen needles in the saw notch of stump. Although these indications are usually quite clear, uncertainty may arise in some instances. Where this is the case, increment cores are taken from the stump and from a tree standing nearby ("twin tree"). Comparative annual ring diagrams are then plotted, from which the season can, as a rule, be ascertained.

When stumps are found within the circular plot, these should be registered on the sheet according to tree species and stump diameter classes. The stump diameter must, however, be converted to the breast-height diameter in order to enable the volume of the felled trees to be computed. To this end, one or two sample trees ("twin trees") per plot of the species occurring are calipered, both at stump height and breast height. These twin trees should be situated on the plot itself or in its immediate vicinity (the same stand), and their stump diameters should roughly correspond to the diameters of the stumps in question. In addition the age class of the twin trees and the productivity class of the site is recorded. When computing the quantity cut, the felled trees are grouped together in breast-height-diameter classes and subdivided into age and site classes. The volume is then obtained by taking empirical mean heights for different ages and sites of trees marked for cutting.

Performance

The new national forest inventory annually surveys about 1,000 survey tracts, 10,000 sample plots for stock taking on forest land, and 40,000 sample plots for stump enumeration, likewise on forest land; approximately 20,000 sample trees are measured annually.

Compiling the survey material

All data from the field work are registered on punched cards (the Powers system). The forms filled up in the field are sent in weekly to the central bureau in Stockholm. Here the forms are first carefully checked. The data are then entered on the cards by means of a punching machine in accordance with the codes given on the form for each class of data. The codes refer to the columns on the punched cards, and the machine produces perforations in the cards in a position corresponding to the code in question. Four different types of cards are used, corresponding to the four forms employed for field work, namely one type for punching the data from the area register along the survey line, a second for all the descriptive data and the tree-tally on the sample plots, a third for the sample-tree measurements, and finally, a fourth card for the stump enumeration. In order to check the punching operation the cards are repunched from the original forms by a second operator. The cards are then passed through an automatic verifier, which checks the agreement between the original punching and the repunching. When it is desired to extract information from the punched records, the latter are placed in the automatic sorter. This machine, by mechanically registering with the perforations in the cards, automatically groups and arranges them in whatever order may be required for the further work of compilation. If necessary, the cards thus arranged are then placed in the so-called tabulator which adds up and converts the information represented by the perforations into figures and prints the results on special lists. The final tables are then prepared on the basis of these tabulator lists.

Results

As mentioned earlier, the annual area actually surveyed constitutes a very small percentage of the total land area. The standard errors do not, however, exceed $\pm$ 1.3 percent for the cubic volume per hectare for instance in the whole country; on the completion of the survey cycle of 10 years this figure will be reduced to only $\pm$ 0.5 percent. This implies that in 100 similar samplings the result in 95 cases would lie within twice this margin of precision. The standard error in the estimate of the annual total quantity felled according to the stump enumeration is $\pm$ 4 to 5 percent. Concerning the results hitherto achieved, see Tables 1 to 5.

Organization

During the field work season, 12 to 14 survey crews are at work each summer. The central bureau organization is represented by the Department for Forest

Survey of the Forest Research Institute of Sweden in Stockholm; this department employs some 30 persons.

The inventory is facilitated by the fact that the survey crews are equipped with a Volkswagen motorbus.

Table 1. – Total Stock according to the Surveys in 1953 and 1954

Region	Forest area, in millions of ha.	Total stock in millions of m³				Increase, percent	Number of years between the surveys
		Survey 1953	Survey 1954	Surveys 1953/54	Previous survey (1938-52)		
I–II	11.2	796	828	815	723	+ 12.7	13.0
III–V	11.7	1 327	1 329	1 327	1 193	+ 11.2	6.0
I–V	22.9	2 123	2 157	2 142	1 916	+ 11.8	9.5

Table 2. – Distribution of Growing Stock by Tree Species: Regions I-V

Species	Total stock, in millions of m³		Increase compared with survey of 1938-52, percent		
	1953/54	Previous Survey (1938-52)	1953/54	1953	1954
Pine	861	769	+ 12	+ 11	+ 13
Spruce	953	844	+ 13	+ 11	+ 14
Hardwoods	328	303	+ 8	+ 9	+ 8
All species	2 142	1 916	+ 11.8	+ 10.9	+ 12.6

Table 3. – Distribution of Growing Stock according to Diameter Classes: Regions I-V

	Diameter class			
	0–14 cm.	15–24 cm.	25 + cm.	Total
	..... *in millions of cubic meters*			
Previous survey (1938-52)	591	777	548	1 916
Surveys 1953/54	611	861	670	2 142
Increase	..... *percent*			
1953/54	+ 3	+ 11	+ 22	+ 11.8
1953	+ 3	+ 9	+ 20	+ 10.9
1954	+ 2	+ 12	+ 25	+ 12.6

Table 4. – Approximate Figures for the Cubic Volume per Hectare

	Region				
	I	II	III	IV	V
	..... *in cubic meters per hectare*				
Previous survey 1938-52	56	70	86	109	84
Surveys 1953-54	59	84	99	119	95

Table 5. – Preliminary Figures of Annual Cut

Species	1952/53	1953/54
	..... *in millions of cubic meters*	
Pine	13.3	20.9
Spruce	21.8	25.4
Hardwoods	5.0	5.0
All species	40.1	51.3

Note to Tables 1-3. The figures for the separate years 1953 and 1954 (where they do not give the total stock for the whole country) have only been included in the Tables in order to show the results for each of the hitherto completed yearly surveys, as they are not sufficiently accurate for publication.

Note to Tables 1-5. From Table 1 it will be seen that the total growing stock throughout the whole country has increased by 11.8 percent since the previous national forest survey (1938-52), or by an average of 1.2 percent annually. In northern Sweden (Regions I-II) previously surveyed in 1938-41, the increase is slightly less than 1 percent per year, whereas in the southern part of the country (Regions III-V) previously inventoried in 1942-52, the increase is nearly 2 percent per year. The difference between the results for the whole country — 2,123 million cubic meters in 1953 and 2,157 million in 1954 — is only 34 million cubic meters. From the foregoing it may be anticipated that the stock would increase by 20 million cubic meters between these two years; consequently, the agreement between the two results must be regarded as surprisingly satisfactory and must be ascribed in part to pure chance.

Table 2 shows that the relative increase in the growing stock is approximately the same for pine and spruce, and somewhat lower for the hardwoods. The relatively uniform figures for the different years 1953 and 1954 serve in some degree to confirm the probability of the results, even after their distribution into tree species, although partial results of this kind will naturally have a higher mean error than the total results.

With regard to the distribution of the growing stock into diameter classes (Table 3), fairly close agreement is also found between the results obtained in 1953 and 1954. For instance, the mean figure for the increase in the growing stock in diameter class 25 centimeters (25 centimeters or more), namely, 22 percent, must be regarded as fairly accurate, since the two partial results are 20 and 25 percent respectively. The latter figure should apparently be higher than the former on account of the general change in the growing stock in the direction of larger diameters which is obviously occurring.

Table 4 is solely intended to give an outline of the changes in the cubic volume per hectare in the different regions. The new inventory cannot provide more reliable figures after surveys extending over only two years where such a widely differentiated distribution as that into regions is adopted. Nevertheless, even with this distribution the results obtained are by no means improbable.

The results of the stump enumeration as shown in Table 5 agree quite satisfactorily with the figures published by the Royal Board of Private Forestry over the annual cut for the different felling seasons. Complete agreement between the figures of the Board and those of the national forest survey cannot be attained, however, on account of the difficulties involved in getting the corresponding "felling years" to coincide exactly in time, among other reasons.

This article is concluded on page 28.

Shifting Cultivation

An appeal by FAO to governments, research centers, associations and private persons who are in a position to help

FAO Staff

Shifting cultivation, in the humid tropical countries, is the greatest obstacle not only to the immediate increase of agricultural production, but also to the conservation of the production potential for the future, in the form of soils and forests. This has been borne out in several FAO conferences and in correspondence with many Member Governments.

Over the past few years, FAO has undertaken a limited number of case studies, stressing the forestry aspects of the problem. The intention is to follow up the publication of these case studies with analyses of the effects of shifting cultivation on soils and forests, as well as with proposals for improving the situation. This entails the study of all facets of the problem. FAO has, therefore, the intention of mobilizing the contributions of as many scientists as possible to help solve this problem in all interested countries.

In order to reach a better understanding of the problem, an attempt is made in this article to define shifting cultivation, to evaluate its actual dimensions, to postulate its probable causes, to draw the approximate geographical and cultural boundaries of its area and, finally, to project the main lines of action to overcome its disadvantages.

This first step should stimulate interest among those experts who, in one way or another, are in touch with this vast problem. It is with the help of their response to the request made by FAO that real and more systematic co-ordination will become possible. This will be achieved through questionnaires, publications, meetings, seminars and conferences until ideas have crystallized sufficiently for concrete lines of action to be recommended to the various governments interested in the problem.

The blind alley of cultural development

Shifting cultivation is the custom of cultivating clearings scattered in the reservoir of natural vegetation (forest or grass-woodland) and of abandoning them as soon as the soil is exhausted; and this includes the custom of shifting the homesteads in order to follow the cultivator's search for new fertile land.

These nomadic habits have the following grave consequences:

1. The fallow, which restores soil fertility, is identical with natural vegetation which remains outside human control, outside the possibility of improvement.
2. Therefore, soil and forest resources are being wasted by bush fires, erosion and other factors.
3. Man is never induced to intensify his agriculture, nor to proceed with long-term improvements of his land.
4. Having to move away periodically, he does not accumulate any permanent material wealth.
5. Beyond a certain critical limit, the density of population cannot increase as, at the approach to this limit, all the soil becomes degraded and famines redisperse the population.
6. No concentrations or agglomerations of the population can, therefore, take place and no urbanization is possible, which means that the cultivators have to remain economically at a subsistance level, without professional differentiation, without exchange or specialization, i.e., without any possibility of progress.
7. Where cash crops have been introduced in an attempt to raise the standard of living of the cultivators, without altering the methods of cultivation, experience has shown that the destructive effects of shifting cultivation have become even greater.

Co-ordinates — time and space

Shifting cultivation is not only a backward type of agricultural practice. It is also a backward stage of culture in general. In all respects it corresponds to the Neolithic period through which humanity passed between the years 13,000 and 3,000 B.C., considering that the substitution of iron tools for polished stone has made no substantial difference in the way of life.

It is not easy to establish the geographical boundaries of the total area under shifting cultivation because of the transitory types of culture which surround it, but very roughly one could estimate it at 14 million square miles (36 million km.) inhabited by some 200 million people. The average density of only 14 men per square mile (6 per sq. km.) is so low that a world in expansion cannot tolerate this relative vacuum. This does not mean that the vacuum should be filled in by migrations, but every country must be made capable of contributing its share of agricultural produce for the benefit of all.

Moreover, the industrialization of underdeveloped countries, if proceeding ahead of the stabilization and improvement of rural life, increases "social distances" between lower and upper classes of society, and this tends to throw it back to obsolete authoritarian forms of social structure.

Ecological causes

The area of shifting cultivation corresponds to the rainy tropics, with the exception of all those parts of it where a rich and stable soil permits continuous cultivation, as for example on recent alluvia, on volcanic soils and in high altitudes. It seems to be established that the factor which keeps people at the level of shifting cultivation is in the first place the rapidity with which tropical soils lose their fertility (i.e., their lack of retaining capacity of plant nutrients) and undergo undesirable changes in physical conditions. These difficulties can be split into several factors — low adsorption capacity for exchangeable bases of the soils' clay fractions, the tendency of these clays to immobilize phosphates, the heavy percolation rate of tropical rains through generally very porous soils and the resulting leaching of plant nutrients, the rapid destruction of organic matter by bacterial action under conditions of high temperatures, and so on.

Where man has to deal with a rapid destruction of soil fertility under conditions of denudation for the purpose of cultivating annual crops, and where he possesses no other means of restoring soil fertility than natural green fallow, he lives in too narrow a dependency on the natural order, without being able to take it under his social and technical control.

Types of shifting cultivation and cultural boundaries

The most primitive type of shifting cultivation can be found presumably in equatorial forest areas, where the cultivation of clearings is, economically speaking, no more than a small additional resource to the still more primitive stage of hunting and gathering. On the fringes of the humid tropical belt, in the savanna, more elaborate systems of agriculture are the custom.

Where the homesteads are small, being restricted to family groups, the periodicity of moving is rapid. Where on the other hand village units are big, their nomadic character may be less obviously apparent. In such cases, soil destruction does not immediately lead to migration but to fields being further and further removed from the villages, until the stage is reached when a community is faced with economic catastrophe and eventually has to move and settle elsewhere. Areas of such occurrence should also be considered as forming part of the shifting cultivation zone.

On the perimeter of the humid tropics, where dry seasons are long, agriculture is in most cases practised alongside with cattle breeding. Conventionally one could consider that pastoral nomadism starts where the main reason for moving the homestead is a search for seasonal pastures, whereas the area of shifting cultivation extends to where migrations are due to an agricultural incentive.

In the neighborhood of areas where soils are enriched by river deposits, there are generally accumulations of people who follow a sedentary way of life. If such areas are sufficiently big to be economically independent, they are obviously outside shifting cultivation. Where, however, a certain amount of rice is grown in marshes by people who otherwise practise shifting dry farming, they, also, could be included in the area. The same applies to pockets of completely sedentary rice-growing communities wherever these are scattered amongst shifting cultivators.

As the altitude increases the soils gradually lose their defect of a transient fertility, and it is not exceptional to see sedentary populations practising continuous cultivation on tropical plateaus, although culturally they are almost at the same level as shifting cultivators. In a study of shifting cultivation these areas are of interest for the purpose of establishing comparisons.

Finally, wherever countries which ecologically belong to the area of shifting cultivation have long been in contact with old civilizations, several transitional cultural levels might have developed which are eminently important in the study of means of overcoming shifting cultivation.

Means of action

At a first glance, three points of attack seem feasible. The first would deal with the main ecological limiting factor, namely the rapid loss of soil fertility. The second would consist in the adaptation of all inventions of modern life which could help the shifting cultivators to emerge from their blind alley, and this even where the first line of action should yield but meager results. The third line of attack would involve methods of guiding the major social change involved in the transition from a nomadic way of life to a sedentary one and to civilization. This major social change will be necessary in any case, whether grafted on improved soil conditions or on the introduction of various agricultural and technological improvements, or both.

Soil science research

FAO would be particularly grateful for all suggestions for research in soil science directed towards the solution of the problem as stated above. In the first place, the overall productivity of tropical soils could be increased by appropriate methods of soil management and especially by intensifying and improving the regenerative effect of the fallows. This is achieved first by protecting the fallow, but could be further enhanced by replacing the natural bush and grass fallows by planted scrub and grass fallows and finally by fertilizing these. Other actions such as finding means of making the effect of fertilizers last longer, and even altering the structure of the soil, may be suggested. At this stage, it is not wise to limit the choice of suggestions and the lines of approach as much may still have escaped attention. Accounts of all the experience so far acquired in experimental work, especially along the lines of the corridor system as practised in the Belgian Congo, would be very gladly received.

There is a particular need for a critical evaluation of the benefits that accrue to the tropical soils from natural fallows. Such an evaluation may open the door to revo-

lutionary improvements in the management of these soils and thus provide the foundation for a radical improvement in the lives of people in the areas of shifting cultivation.

Agricultural and technical adaptations

In many countries, attempts have been made to fix shifting population by resettlement. This has yielded positive results only where the establishment of appropriate crop rotations has been introduced in local practice. The introduction of a crop rotation is dependent on alterations in land tenure systems and with them the social structures. As soon as this fundamental measure of introducing crop rotations was taken — in other words, as soon as a technical and legal basis was created for the exercise of a certain control over the fallow — a number of other measures became possible. In the first place, as already mentioned, an intensification of the fallow by protecting, planting and manuring it, in turn opens up possibilities for mechanizing cultivation. The establishment of permanent roads and paths has made it possible to shorten distances by mechanizing transport. This also makes it possible to introduce time-saving devices such as collectively-owned pumps and mills. Some of the production of food in a sedentary way of life has been taken over by permanent tree-plantation, which conserves the soil better than annuals, and some by the creation and stocking of fishponds. Finally, all this leads to the possibility of increasing productivity by means of exchange and specialization, including an occupational differentiation between craftsmanship, cattle breeding, agriculture and forestry.

It would be desirable to make an inventory of any application of these and other interdependent measures, and to relate their success to demographic conditions (critical minima and maxima of population densities), to nutritional and economic conditions (measurable not by money incomes but preferably in units of effort at the production end, in calories and units of protein at the consumption end), and to social and cultural conditions, i.e., to the people's contentment, to the degree of their participation in progress and their acceptance of it.

The guided social change

Until now, the cultural development of humanity has followed a process of trial and error, which is not only slow but also dangerous as it leads through crises and catastrophes. Even at present the "acculturation" of backward people, despite the experience of history at our disposal, is carried out by methods not planned in advance. In order to raise 200 million people in one or two generations to a point of cultural evolution which has normally taken some 5,000 years to attain, and in order to do it smoothly, crushing neither the forces of cohesion of the society nor its adhesion to the natural environment, one may need to devise new, more appropriate methods of education and of administration.

Considering the great cultural disparity between the level of the people concerned and that of the scientists who should be entrusted with initiating the social change, it might be essential to open up and ensure new channels for the participation of the people in the direction of their own movement.

It seems also necessary to revise survey methods for the study of ecological conditions (soil, phytosociology, ecoclimate) and cultural conditions (social structures, land tenure and customary systems of agriculture) which together form the starting point to the social change. Until now, surveys give but little information on the logical connection between environment and culture.

Moreover, sufficiently definite criteria are not yet available for judging the progress of the social change, in order to adjust the reforms if need be.

It should be of the greatest importance to gather all documentation possible on recently acquired experience in appropriate methods of regional planning.

FAO appeal

It is only by co-ordinating the work of various specialists that positive contributions will become possible. The level at which this co-ordination is probably the most important, is that of the small problem areas in which contact between the tutors initiating progress and the populations which will have to profit from it is actually established.

Nevertheless, it is also important to centralize all the documentation available on the problem at an international level and to co-ordinate the theoretical work on means of overcoming shifting cultivation. That is what FAO proposes to do.

It appeals to all those who have acquired experience in the various branches connected with the problem to help by sending in suggestions and criticism and by indicating bibliographical sources at their disposal. The next step will be to issue systematic questionnaires, each adapted to the disciplines involved.

From universities, FAO would like to receive suggestions concerning the best methods of training teams of specialists and inter-disciplinary co-ordinators who will be required for the campaign to overcome shifting cultivation.

NOTE: *All those wishing to keep in touch with FAO on the subject of shifting cultivation are asked to communicate with the Director, Agriculture Division, or the Director, Forestry Division, at FAO Headquarters, Rome.*

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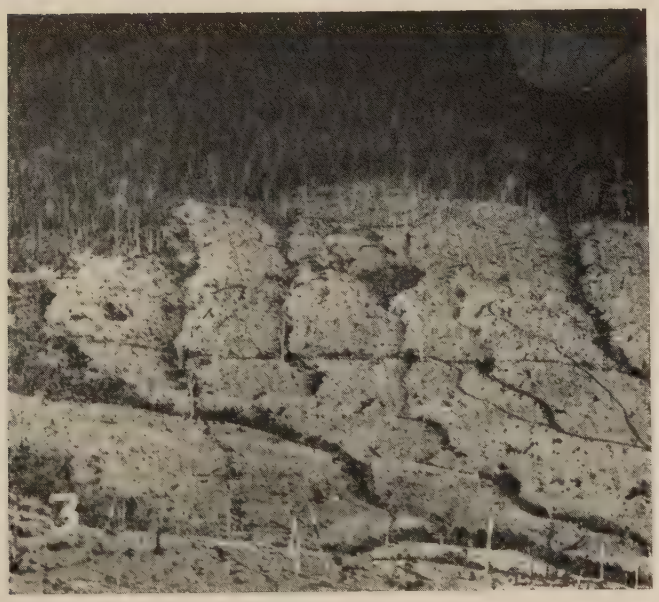
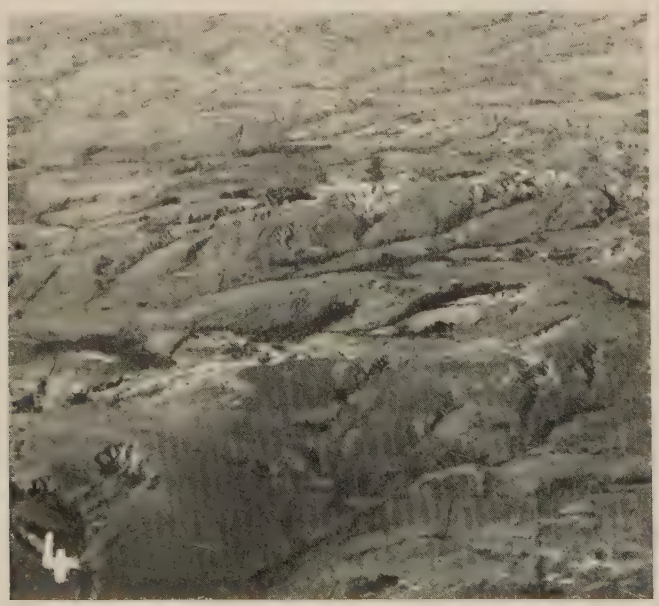




THE FAO Regional Forestry Officer for Latin America has been distributing this instructive set of photographs to Ministers and officials in the countries of his region.

The photographs show how virgin forest is transformed into a desert by being badly exploited and burned, a tragedy which can be avoided if the forests are properly cut-over and reforested.

Combining forestry with intermediate agriculture lowers the cost of reforestation considerably, provides additional food and helps to get a better growth. Planting of corn for one or two years followed by a legume (if possible perennial) will probably give good results, as the corn protects the young trees against excessive heat in the dry season and the legume is a good fertilizer. These photographs show only conifers, but this system could probably be also applied to broadleaved species.

FIGURE 1. *The virgin forest.*

FIGURE 2. *Forest badly exploited and burned.*

FIGURE 3. *Five years later.*

FIGURE 4. *The final result.*

and a Remedy

FIGURE 5. *Plantation of* Araucaria angustifolia (*Pinho do Paraná*) *in the State of Minas Geraes, Brazil. Altitude: 1,400 meters. Rainfall: 1,500 millimeters (6 to 7 months' dry season).* Araucaria (*sown July 1954*) *and corn (sown for the first time in September 1954). Yield of corn in two years - 1,500 kilograms per hectare. Soil: medium quality. Photograph taken in January 1956.*

FIGURE 6. *Plantation of* Pinus radiata (insignis) *in Ecuador. Altitude: 2,350 meters. Rainfall: 450 millimeters (in 3 months). Poor soil. Pinus planted in 1952 (one-year-old seedlings). 3 years' corn. Photograph taken in April 1955.*

FIGURE 7. Araucaria angustifolia *in the State of São Paulo, Brazil. Altitude: 900 meters. Rainfall: 1,300 millimeters (summer). Soil: medium quality.* Araucaria *sown in 1954. Legume* (Canavalia ensiformis) *as green fertilizer. Photograph taken in January 1956.*

FIGURE 8. Cunninghamia lanceolata (*a species from China*) *in the State of Minas Geraes, Brazil. Altitude: 1,400 meters. Rainfall: 1,500 millimeters (6 to 7 months' dry season). Soil: medium quality. 1953 - as one-year-old seedlings planted together with beans; 1954 - corn. Photograph taken in January 1956.*

Regional Climates and Vegetation

Professor Sir Harry Champion and N. V. Brasnett,
Imperial Forestry Institute, Oxford

This article is an excerpt from a forthcoming FAO publication, Choice of Tree Species for Planting, *prepared by the authors at the request of the Forestry Division. It deals with the factors which should guide the forester in deciding which species to select for planting, or to favor in silvicultural operations in artificially established forests. Among the elements analysed, apart from the actual site conditions themselves, are silvicultural, economic and social factors. The long-term effects, as well as the prospects of early results offered by the species favored, must be kept in mind.*

A forester faced with the practical problems of choosing what species to plant on a given site, or of selecting sites and species for the production of a particular type of timber, needs a detailed knowledge of the local climates and plant associations of his territory. This will direct him to other areas on which he might be able to draw for additional species. He will, of course, have made himself familiar with all available relevant experience whether published or to be found in the files of the various organizations concerned with natural history, land use, biological, geological, climatological and hydrological research in his country. He will also have studied the topography, soils and vegetation, both natural and artificial, of the tract in question and of other parts of the country having similar conditions.

If he believes that his purpose may be served best by the trial of exotic species, he will obviously first consider making introductions from homoclimes or climatic analogues. He will turn to zones of similar and similarly distributed rainfall and temperatures with similar latitudes and topography, and seek detailed information about the distribution and growth there of useful species, and the types of soil on which they grow.

These zones will be indicated somewhat vaguely on climatological maps of the world, and more detail about them will be available in local regional maps and in tables of climatological data published in the regions. Then the forester can generally turn to a local flora of the region to ascertain what grows there, and often he will be able to follow up the species which arouse his interest in monographs or other papers dealing with them. If he is fortunate, he will find works such as *Applied Silviculture in the United States* (Westveld, 2nd. ed. 1949) and *The Silviculture of Indian Trees* (Troup, 1921), which will give him climatic, ecological and silvicultural information about the trees of considerable areas. Records of trials of species in different parts of the world such as are to be found in *Exotic Forest Trees in the British Empire* (Troup, 1932) will also be useful. If he has reason to think that some members of the genus *Eucalyptus* might be of value to him, he can turn to the FAO publication *Eucalypts for Planting* (Métro, 1954) the various reports of the FAO Eucalyptus Study Tour (1952) and others of the 300 or so publications listed in the bibliography of that book, and the *Forest Seed Directory* (FAO 1956), which lists 118 eucalypt species classified according to their suitability to grow in any of 18 climatic zones. Other Australian trees besides the eucalypts are included in *A Reconnaissance of the Forest Trees of Australia from the point of view of their cultivation in South Africa* (Robertson, 1926).

There is, of course, nothing new about this. Horticulturists and foresters have for many years looked to countries with climates similar to their own, visited them and brought back seed of species which they thought might make promising additions to their local floras. The only difference now is that very much more information is available, and that reliable seed can be obtained from the zones selected without difficulty or resort to smuggling as was sometimes necessary in the past.

As an example, it may be noted that in 1823 Douglas was sent to North America by the Royal Horticultural Society of London because it was realized that the Pacific Coast region was the home of a particularly rich flora growing in a climate comparable to some parts of the British Isles. This region from Oregon northwards through Washington and British Columbia to southeast Alaska and bounded on the east by the Coastal Ranges contains a far wider range of climate than does Britain, but the temperature regime at the mouth of the Columbia River around latitude 46° N., with an average in summer of 54° F. (13° C.) and an average for the year of 50° F. (11° C.), is similar to that of the English south coast, latitude about 50.5° N.; and Sitka in Alaska, latitude 57° N., closely matches the northwest coast of Scotland. The rainfall on the Pacific coast is of the winter type with midsummer the driest period, whereas in Britain spring is relatively dry. Further north up the coast the proportion of rain falling in the summer is greater, until in southeast Alaska it is close to the 22 percent commonly found in Britain. Inland, the climate becomes rapidly continental and summer temperatures are higher than in England.

The trees of the region important to forestry in Britain and parts of western Europe have been found to be Sitka

spruce, Douglas fir, *Pinus contorta* Dougl., *Abies grandis* Indl., *Tsuga heterophylla* Sarg. and *Thuya plicata* Don. All penetrate into climates of much lower winter temperature than are found in Britain, and Douglas fir and the *Abies* than those of Britain, in particular grow best in warmer summer temperatures averaging 52° to 56° F. (11.1°-13.3° C.) though there is no reason to suppose that they are limited by summer temperature (Wood, 1955). In their native habitat, neither Douglas fir nor Sitka spruce appear to form part of climax forest communities, but are pioneer species giving way to *Tsuga*, *Thuya* and *Abies*. Sitka spruce thrives at low elevations in the British Columbian region with mean annual temperatures varying from 44° to 49° F. (6.7°-9.4° C.), summer mean of 55° to 68° F. (12.8°-20° C.), winter mean of 30° to 38° F. (1.1°-3.3° C.) and a rainfall of 40 inches (1,020 mm.) a year upwards, conditions which can easily be matched in Britain.

It is now possible to buy from government forest departments and from merchants seed certified as collected from known climatic and elevational zones in this region as from several other regions of the world. The *Forest Seed Directory* mentioned above contains the forms of agreed international certificates of origin and quality, and the sources from which a large number of species can be obtained. One firm divides its collection area on the Pacific coast from Alaska to California into 25 climatic regions, subdivided into 127 zones, each of which is further split up into 500 foot (150 m.) elevation bands. It provides tables which give the temperatures (average annual, average summer, absolute maximum and absolute minimum), precipitation (annual and summer), and the number of frost-free days in the year, for the most representative weather station in each zone.

Another country which was drawn on early for plantation species was Australia. In 1843, several species of eucalypt were tried in the Nilgiri Hills of India, and later *Eucalyptus globulus* Labill. solved a serious fuel shortage there. In 1870, *Acacia mollissima* Willd. was introduced into Natal and eastern Transvaal in South Africa and by 1952 a great tanbark industry depending on some 640,000 acres (259,000 ha.) of black wattle plantations had been built up. In 1876, *Eucalyptus saligna* Sm. was first planted for railway fuel in South Africa, and now there are some 200,000 acres (80,000 ha.) of it in eastern and northern Transvaal and on the Zululand coast. Early in the present century, the *Companhia Paulista de Estradas de Ferro*, the State railway of Saõ Paulo, Brazil, imported 143 species of eucalypts and now has some 30,000 acres (12,000 ha.) of plantations, mainly of *E. camaldulensis* Dahn., *E. citriodora* Hook and *E. saligna*. The Mediterranean countries, Spain, Portugal, France, Italy and Greece, have all found *E. globulus* and *E. camaldulensis* valuable additions to their plantation species. In California, 80 percent of the considerable eucalypt plantations are of *E. globulus*, and 15 percent of *E. camaldulensis*. Peru, Chile and Uruguay all make considerable use of *E. globulus*, while in Turkey, Cyprus, Palestine, Jordan, Tripolitania and Morocco the most popular eucalypt is *E. camaldulensis*. Many other species are found to be suitable to particular parts of these and many other countries.

It is, therefore, worth considering the climate and vegetation of the Australian continent. Australia has a central desert zone covering nearly 40 percent of its whole area, and the rest can be divided very roughly into three main climatic zones:

1. A tropical northern zone of summer rainfall, north of about 20° S. on the west coast and about 14° S. on the east coast. The mean annual rainfall varies from about 20 inches (510 mm.) in the south of the zone to 60 inches (1,525 mm.) and more on the north and east coasts, with some areas receiving 120 inches (3,050 mm.). The mean annual temperature is in the neighborhood of 80° F. (26.4° C.), the interior being warmer than the coastal areas and the west coast warmer than the east.
2. A zone of moderate winter rainfall and dry summers in the southern parts of South Australia, Western Australia, the greater part of Victoria, and the south of New South Wales. Mean annual rainfall varies from about 10 inches (250 mm.) to about 30 inches (760 mm.) with isolated areas of up to 40 inches (1,020 mm.) on the south coast. Summer temperatures are around 70° F. (21.1° C.) and winter temperatures around 35° F. (1.7° C.)
3. A zone of more uniformly distributed rainfall on the east coast and the southeastern part of the continent with annual rainfall generally between 20 inches (510 mm.) and 60 inches (1,525 mm.). This zone includes the mountains of New South Wales, and there and on the east coast the rainfall is from 40 to 60 inches (1,020-1,525 mm.) a year, with isolated areas of 120 inches (3,050 mm.) on the coast of northern Queensland, where the summer is the wetter season. In the south (Victoria), there is a tendency towards a maximum rainfall in winter. In New South Wales, the even distribution is more noticeable, though in the north and on the east coast more rain falls in summer, and on the south coast more in winter. There are very considerable variations in temperature regimes within the zone, because of the topography.

De Beuzville (1943) considered that the whole of the east coast of Australia has a climate predominantly similar to that of Argentine, Brazil and Mexico and certain parts of South Africa, and also, in its wetter parts, in Madagascar. The north coast and its hinterland has a climate similar to those of parts of Madagascar, India and Mozambique. On the west coast and inland from it there are stations with climates similar to some found in South Africa, Algeria, Sudan, Mexico and

Arizona. The climate in the south and southwest is more like that of California and South Africa, and in small areas like that of Spain. The Australian Alps and the Dividing Range have cool slopes where the climate approximates to that of France and Italy. The dry center of Australia has a climate similar to that of Egypt, Arizona, Israel and parts of the Californian desert. Robertson (1926) found that, while coastal temperatures, latitude for latitude, were very similar in Australia and South Africa, the interior of Australia was warmer than that of South Africa because of the greater elevation of the latter.

The forest formations of Australia may be roughly divided into Rain Forest (tropical, sub-tropical, and temperate), Moist Sclerophyllous Forest, Dry Sclerophyllous Forest, and Open Woodland, all of which merge into each other.

The rain forests occur only in isolated relict patches. In the tropical zone their flora is Malayan without predominant species, and the natural succession is very confused. From the Hastings River, about 30° S., in New South Wales to the north of Queensland, *Araucaria cunninghammii* Ait is found on the coast and up to 100 miles (160 km.) inland with an annual rainfall of 50 to 70 inches (1,270-1,780 mm.), falling mainly in summer. *Araucaria bidwillii* Hock. and *Agathis robusta* are found in southeast Queensland in areas with 50-60 inches (1,270-1,525 mm.) summer rain, with summer temperatures of 75° to 85° F. (24°-29° C.) and winter temperatures of 50° to 60° F. (10°-16° C.). What are apparently secondary forest formation after fires include *Tristania conferta* R. Br. and *Syncarpia laurifolia* Ten. mixed with eucalypts such as *Eucalyptus saligna*.

The sclerophyllous formations are mainly composed of eucalypts and acacias. Closed stands of *Eucalyptus* are not usually found where the rainfall is less than 30 inches (760 mm.) a year, below which limit open and scrubby vegetation occurs. Many of the eucalypt species are confined to particular zones of rainfall amount and distribution, but some are very adaptable. One of the most widely distributed is *E. camaldulensis* which Boosman (1950) states can put up with 5 to 10 inches (130-250 mm.) of rain a year, is often found in zones of 22 to 28 inches (560-710 mm.), and exceptionally with 40 to 45 inches (1,020-1,140 mm.) though 35 inches (890 mm.) is regarded as its normal maximum. Actually its range is determined more by soil moisture conditions than by precipitation and it is characteristic of alluvial flats, often along river banks where water is available by inundation or percolation. It likes warmth and extends into some of the hottest parts of the Northern Territory. It is not found in the highlands of New South Wales in which State de Beuzville (1943) gives a mean temperature of the coldest month of 46° F. (7.8° C.) as the lower thermal limit of its range. It must be remembered that the form, as well as the stand density, of eucalypt species growing in areas of their minimum rainfall is very different from what it is under optimum rainfall.

Moist sclerophyllous forest is found mainly in the southeastern coastal strip of New South Wales and Victoria, and in the southwest corner of Western Australia, in the zones of either winter or fairly uniform rainfall. In Western Australia, *Eucalyptus diversicolor* F. v. M. is found in stands of a type approaching temperate rainforest in a climate of 40 to 60 inches (1,020-1,525 mm.) mean annual rainfall and mean annual temperatures of 62° to 65° F. (16.7°-18.6° C.) In Victoria and New South Wales, *Eucalyptus globulus* grows in the higher and cooler sites with 35 to 65 inches (890-1,650 mm.) of rain and mean annual temperatures of 44° to 49° F. (6.7°-9.4° C.) sometimes mixed with *Acacia melanoxylon* R. Br. and with an understorey of *Acacia mollissima* Wild. or *A. dealbata* Link. In the wetter range of these sites in Victoria, stands of *Eucalyptus regnans* F. v. M. are found.

Eucalyptus gomphocephala A. Dc. with an undergrowth of *Acacia cyanophylla* Lindl. is found growing on calcareous sands in the southwest of Western Australia in an annual rainfall of 30 to 40 inches (760-1,020 mm.) mainly in winter, with an annual mean temperature of 60° to 64° F. (15.6°-17.8° C.) and a summer temperature of 67° to 72° F. (19.4°-22.2° C.). There are either no frosts or only occasional light ones in places. Both species have proved valuable in the afforestation of coastal sand in South Africa, and more recently have shown considerable promise when used in combination on calcareous sand dunes in Morocco (FAO, 1954)

In the dry sclerophyllous forests there is a very great variety of eucalypt species, not many of which attain timber dimensions in the lower rainfall areas. In New South Wales and Queensland, *Eucalypts crebra* F. v. M. grows with a rainfall of 20 to 26 inches (510-660 mm.) a year mainly in summer in areas of high temperature, often mixed with *Callitris glauca* R. Br. *Eucalypts sideroxylon* A. Cunn. is found in poor sites in New South Wales, Victoria and Queensland with about 20 inches (510 mm.) of rain a year. There are also species which are characteristic of moister forests but nevertheless can grow with as little as 22 to 25 inches (560-635 mm.) a year, such as *Eucalypts marginata* Sm. in Western Australia, and *E. obliqua* l'Herit. in South Australia, Victoria and New South Wales. Where there is moisture enough to permit of undergrowth, this is often *Acacia pycnantha* or *A. mollissima* in the east, and *A. cyanophylla* or *A. cyclops* Cunn. in the west.

These formations merge into open woodland, particularly in western Queensland and New South Wales. *Eucalypts salmonophloia* F. v. M. grow in Western Australia in the zone of 9 to 12 inches (220-305 mm.) of rain, mainly from June to September. 'Mallee' formations consisting of a great variety of small, often bush-like, eucalypts attaining up to 20 feet (6 m.) in height with stems of 3 to 6 inches (7.6-15.2 cm.) in diameter, cover considerable areas of low rainfall.

South Africa is a good example of a country with inadequate natural forests and slow-growing indigenous

species. The need to supplement the natural flora was recognized early. Conifers and hardwoods were imported from northern Europe from 1665, but did not thrive. Later some Mediterranean species, notably *Pinus pinea* L., which became naturalized in the Cape Peninsula, and *Pinus pinaster* Sol., which has been widely planted and does best in the zone with winter or all-the-year-round rainfall, were introduced. By the middle of the nineteenth century P. *radiata* had been brought from California and had proved to be very adaptable in climates similar to those favored by *P. pinaster*, though more particular about soil. Later in the century, *P. longifolia* Roxb. was introduced from the outer ranges of the Himalayas in India and proved useful in the cool and warm temperate summer rainfall areas.

A great step forward was made about 1905 when Hutchins decided that Mexico, a plateau country like the Transvaal, lying in approximately similar latitudes, having a summer rainfall and a rich flora, should be a promising source of exotics. He tried a number of species including *Pinus patula* Seem. of which there is now a bigger acreage in South Africa that that of any other softwood, particularly, of course, in the summer rainfall areas. Hutchins also recommended P. *caribaea* Morelet from the southern United States of America for the sub-tropical zone, and it has shown exceptionally vigorous growth in both the temperate and sub-tropical zones with winter or all-the-year-round rainfall. It is being planted on a large scale for paper pulp in Zululand. By 1947, some nervousness was felt about the dangers of disease in large pure blocks of these two species and an officer was sent to America to study the pines in their natural habitats and to find additional species if possible (Loock, 1950). He was particularly interested in *Pinus pseudostrobus* Lind. which had originally been tried under the name of *P. teocote* Schl. v Cham. with success, but the seed of which could not be obtained. He was able to collect 350 pounds (159 kg.) of seed in Mexico. He was also impressed by *Pinus hondurensia* Loock in British Honduras, only lately distinguished from *P. caribaea*. This illustrates the importance of botanical identification and of securing seed of the most suitable species and varieties for use in particular localities. Where reliable local agencies for the supply of seed do not exist it may be necessary to go and collect exactly what is wanted.

These conifers and others from California, Central America, India, the Mediterranean region, and Mexico now cover more than 600,000 acres (243,000 ha.) of South Africa, alongside some 640,000 acres (259,000 ha.) of acacias and 450,000 acres (186,000 ha.) of eucalypts from Australia, an example of what can be done by selection and trial of species from climates similar to those in which they are required to grow.

Reference is made earlier, in the study of which this article is an exerpt, to the agro-climatic analogues established at the American Institute of Crop Ecology by Nuttonson (1937-53). Up to the latter year analogues had been established between North America and Ukraine, Poland, Czechoslovakia, Yugoslavia, Greece, Albania, China, Germany, Finland Sweden, Norway, Siberia, Japan, and the Ryukyu Islands. Each of these studies gives a general and comparative geography of the country covered and a brief account of its climate. There is also a varying amount of information about the natural resources of the country, its soils, major plant species, land-use, agricultural and forestry practices, etc. Relief maps show the location of the meteorological stations within the country studied and the regions of any North American climatic counterparts found. Charts give full meterological data for each station and for the counterparts.

The purpose of this series of studies is " to formulate an agronomic and horticultural approach to ecology and to promote research along the lines of crop ecology as it affects plant adaptation, plant introduction, and the exchange of varietal plant material among the various agricultural areas of the worlds ". Its value is not, however, confined to agriculturists. For instance, the paper on Japan (1951) points out:

> " Over one half of the total land area of the country is covered with luxuriant forests of a great diversity of broadleaved and coniferous species and of dense undergrowth. These forests are found largely in the mountainous regions, as more than three-fourths of the country's land consists of rough and rugged mountains and hills topographically unsuitable for cultivation of farm crops. "

The climate of Japan is largely determined by the prevalence of the monsoons. There is an abundance of precipitation throughout the year with a predominantly summer-maximum distribution pattern, high relative humidity, and high summer temperatures, except in the higher latitudes and altitudes. Nuttonson mapped and described eight climatic regions, two of which he subdivided into three and two districts respectively, and provided graphs of average monthly temperatures, monthly rainfall, and frostless seasons from 16 weather stations. Unfortunately, because the study is mainly concerned with agriculture, not a great deal of information is given about the climates in the mountain forests, where the trees of greatest interest to other countries grow. Data for two high level stations in central Honshu are:

Latitude	Elevation		Mean annual rainfall		Mean annual temperature		Mean Jan. temperature		Mean August temperature	
	ft.	m.	inch.	mm.	F.	C.	F.	C.	F.	C.
35° 28′	3 687	1 124	73.9	1 877	45.3°	7.4°	24.8°	4.0°	66.0°	18.9°
35° 25′	4 514	1 376	92.1	2 339	41.7°	5.4°	19.9°	6.7°	64.0°	17.8°

These figures are quoted because they are probably typical of the natural habitat of two of the most important conifers, *Cryptomeria japonica* Den. and *Chama-*

ecyparis obtusa Sieb. About one-third of the total forest area of Japan consists of plantations and they are being extended at a rate of about 720,000 acres (292,000 ha.) a year. In the best sites in the moister inter-mountain valleys and on the lower slopes *Cryptomeria* is planted, on the middle and upper slopes *Chamaecyparis*, and on the ridges from about 6,000 to 7,000 feet (1,830-2,130 m.) elevation, *Pinus densiflora* Sieb. According to Turner (1937), *Larix leptolepia* Murr. is the species most used for planting in Hokkaido. It is also native to the volcanic mountain soils between altitudes of 4,000 and 6,000 feet (1,220-1,830 m.) elevation.

Nuttonson divided the natural forests into three climatic types, each of which descends in general to lower altitudes in the northern latitudes and ascends in the southern. This classification agrees fairly closely with one drawn up in 1922 which is quoted by Ohmasa (1956).

1. *Evergreen hardwood forest*, which contains some deciduous hardwood trees and some conifers. It lies mainly south of latitude 36° N. and covers Kyushu from sea level up to about 2,800 feet (850 m.) elevation, Shikoku to 2,450 feet (750 m.) and southern Honshu to about 1,800 feet (550 m.). The mean annual air temperature is 55°-70° F. (13°-21° C.) and there is a well-distributed rainfall with a summer maximum. The more important species are *Quercus gilva*, other *Quercus* spp. and *Cinnamomum camphora*. *Pinus thunbergii* Parl. is found on the sea coast.
2. *Deciduous hardwood forest*, which includes mixtures and pure stands of economically important conifers, is found to the north of the evergreen hardwood forest and at elevations above it, reaching latitude 43.5° N. at sea level in the middle portion of Hokkaido. The formation covers the highest elevations found in Kyushu, but only land up to 6,500 feet (2,000 m.) elevation in Shikoku, to 3,600 feet (1,100 m.) in northern Honshu, and to 1,500 feet (450 m.) in southern Hokkaido. The annual mean air temperature of the zone is from 43°-55° F. (6°-13° C.) Valuable hardwoods include *Fagus crenata*, *Quercus crispula*, *Aesculus turbidata* and *Zelkova serrata*. The principal conifers are *Cryptomeria japonica* Den. *Chamaecyparis* spp., *Larix kaempferi* Lamb. and *Pinus densiflora* Sieb.
3. *Coniferous forest* covers the colder northern and more elevated tracts. It does not occur in Kyushu, and in Shikoku only in the small area above 6,500 feet (2,000 m.) elevation. In central Honshu, it is found between about 6,000 and 8,900 feet (1,800-2,700 m.) In southern Hokkaido, the formation covers most of the land above 1,000 feet (305 m.) elevation, and north of latitude 43.5° N. descends to sea level. The annual mean air temperature is 43° F. (6° C.) and below. *Picea jezoensis* Sieb. and *Abies sachalinensis* Mas. are the principal conifers, and are sometimes mixed with *Quercus crispula*, *Tilia japonica*, *Betula tauschii*, etc. *Abies veitchii* Lindl. occurs in the colder parts of the zone.

High relative humidity is a feature of most of Japan, and, while similar thermal conditions to those found in different parts of its wide range of latitudes can be found in North America, it is not so easy to match the distribution of rainfall. However, some homoclimes have been found in the Maritime Provinces of Canada, and many in the northern, central and southern regions of the eastern United States.

Nuttonson, 1947, 1951, has pointed out that in many parts of North America the relatively severe winters compared with Japan do not permit the formulation of year-round thermal analogues in a number of areas in which temperatures in the growing season (April-September) should make possible the harvesting of spring planted crops, and many spring-crop analogues are suggested. Similarly there are winter-crop analogues based on October to April temperatures. This points the difference between agriculture and forestry, in which crops are on the ground throughout the year and year-round temperatures are of more importance.

Control of Brush and Undesirable Trees: IV

Arthur W. Sampson, Professor of Forestry, Emeritus,
and Arnold M. Schultz, Associate Specialist, School of Forestry, University of California

This article is the fourth and last section of a paper which was prepared at the request of FAO. Earlier sections appeared in Unasylva, *Vol. 10, Nos. 1, 3* and *4. Following the publication of this section, the whole series is being made available under a separate cover.*

Conservation in Land Clearing

The intimate relations of soil and climate, and the effects of land treatment on stream flow, have been recognized for decades. Since we live in an environment composed of many facets, the best pattern of land use is not always or immediately discernible. Too often the operator goes in for short-term gains, overlooking the long-term advantages of more conservative use.

Before an operator can be assured that his plan for removing vegetation from his land is sound, it is well that he first considers a few basic principles of wild land management.

Institutional Policies on Land Use

In order to put a given parcel of land to its best permanent uses, be it brushland, savanna, or swamp, the owner or administrator — whether federal or private — must consider the effect of his operational plan on the land in the long run. This precaution applies as well to legislative policies pertaining to disposal of lands under government ownership or control as it does to the private operator. However, avoidance of faulty practices is not always possible in a young country where experience in land use is limited.

The intensive and often irrational use of both farm and publicly-owned wild lands of all countries has in many localities resulted in serious soil loss and in less usable water (Figure 70). Too commonly old stumps and snags show that many inches of soil have been carried by sheet erosion into drainage channels during flash storms and periods of strong winds. As a result, farmers and graziers over much of the world must now till pasture, and conserve the remaining relatively unproductive B-horizon, since most or all of the fertile A-horizon — the virgin top soil — has been lost (*37*).

Figure 70. *Detail of unit area treatment of forest land. A small opening on steep slope, disced on contour to prevent erosion, conserve water, and to prepare a seedbed for a heavy crop of sugar pine seed.*
(U.S. Forest Service)

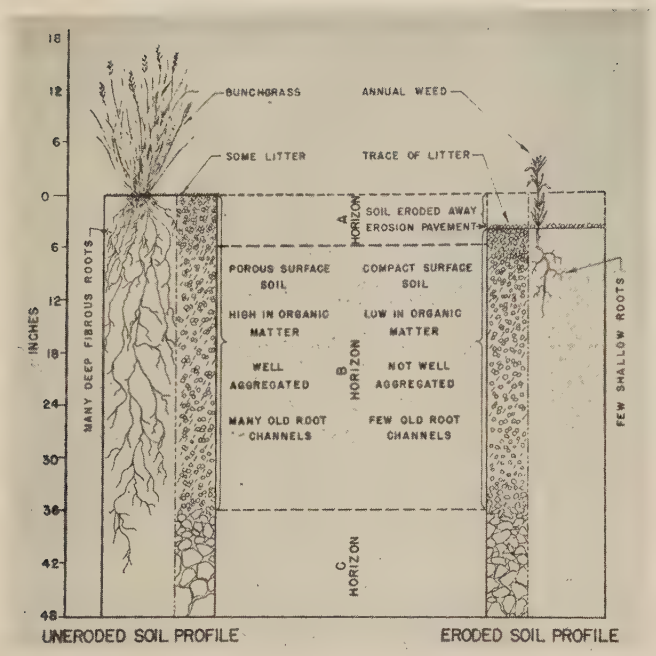


FIGURE 71. *Effect of erosion on soil and vegetation. Diagrammatic sketch to illustrate relative top and root development of characteristic vegetation on badly eroded and on protected soils.* Left, *perennial bunchgrass growing on undisturbed A-horizon topsoil;* right, *annual weed growing on subsoil with A-horizon top soil eroded away. Note contrast in depth and spread of root system to the left.*

(After Sampson [*33*])

PROTECTION OF SOIL AND WATERSHEDS BY VEGETATION

It is well to keep in mind that the primary objectives of soil conservation and watershed management are to stabilize and maintain the natural resources to the greatest extent economically feasible. On wild lands this can best be done by maintaining an abundant and vigorous plant cover (Figure 71).

By maintaining a desirable porosity and permeability the soil absorbs rainfall readily, hence erosion is greatly minimized. The roots also function to maintain permeability. The litter furnishes food for microorganisms which help maintain soil permeability, and the organic matter gives the soil properties to resist compaction. Another important function is the sheltering effect of the soil from direct insolation and desiccating winds, and from the full force of rainstorms (*32*, *33*). On well-vegetated lands a goodly portion of the rainfall is intercepted and released gently to the soil. On the other hand, faulty logging, excessive grazing and wild fires are among the most common causes of upsetting plant-soil relations.

Another effect of vegetation on watershed management is its capacity to withdraw water from the soil and thus, in a measure, reduce water yield. Kittredge (*22*) has estimated annual evapo-transpiration loss from southeastern pine forests at 30 inches (75 cm.) and oak-hickory forests at 20 to 30 inches (50 to 75 cm.). Hoover (*20*) found that a hardwood forest removed from 17 to 22 inches (43 to 56 cm.) of water annually. Since the anatomy of leaves of the various species composing the plant mantles are different, transpiration loss would also be different. To offset this seeming loss by transpiration is the fact that the soil mass is again receptive to water absorption as more rain falls, thus minimizing run-off and erosion.

Closely related to water loss is the character, volume and distribution of the root systems. Grasses have numerous fibrous roots which are localized in the upper few inches of the soil; trees have deep woody roots with few surface rootlets; shrubs also have woody roots but they are less coarse than tree roots and are anchored at depths intermediate to those of grasses and trees. One plant community, therefore, may withdraw moisture from the soil over a much longer period than another composed of different species. On inferior steep slopes brush species, in contrast to grasses and trees, will send down " stringer " roots in rock crevices which will maintain these frugal plants indefinitely. Bleak watershed units should be left undisturbed as no vegetation will serve better than the well-adapted natural cover which they already support. It is, therefore, necessary for the land manager to learn as much as possible about rates of water loss and root system characteristics of the dominant trees and shrubs of his land.

Protection of watersheds against uncontrolled fires is of utmost importance because of the danger of serious damage to the soil. The remaining plants may be deprived of needed water, and the run-off carries with it plant nutrients, ashes, and surface soil, thus lowering the quality of the site. Further soil depletion accrues during dry weather from sheet erosion (*31*).

The time required for a watershed to recover from a severe burn varies according to climate, type of soil, steepness of slope, length of time the soil remains bare, and several other such considerations. Recovery may take several decades or even centuries where much soil has been lost. If left to nature, recovery will pass through the entire sequel of successions and reach the tree stage or climax when the soil is again productive. Seeding and planting, though costly, will greatly speed up the time of recovery.

Whether the amount of usable water is increased or diminished by burning and thinning of the stand remains a moot point. More snow or rain will reach the soil on burns, but surface run off is correspondingly greater.

SUGGESTIONS FOR GOOD LAND MANAGEMENT PRACTICES

Nearly all operators and administrators have encountered from time to time unexpected if not baffling problems in maintaining the desired returns from their lands. Some of the areas may be in need of reforestation, other parts may have a thinned out forage cover, still others may have become brushy. The suggestions which follow may be helpful in meeting some of the problems involved.

Seeding and planting

Reforestation. There is urgent need to re-establish trees on forest lands where the timber has been logged or burned off. After fire or logging watershed values are lowered, and a new tree stand should be started to stabilize the soil and to put the land back into commercial use. This is expensive and requires skill (*30*).

Reforestation by natural means is relied on where adequate trees of desirable species remain. On heavily burned or improperly logged areas, on the other hand, seeding or planting of trees is the only means available for restocking the land.

Range seeding. Prompt re-establishment of a forage cover on cleared grazing land is important for three reasons:

a) to protect the soil from excessive erosion;
b) to curtail establishment of brush seedlings;
c) to provide feed for livestock.

In order to protect the soil, the land should be revegetated the first year after clearing. By careful selection of site and species, and by proper planting and management, earlier and more palatable forage may be obtained than the lands produced when in their virgin state (*10*).

Outstanding features of range management

Attempts seeding of cleared brush or forest lands are doomed to failure if grazing is allowed before the resulting seedlings have developed a strong root system. The fact must not be overlooked that these woody species are hardy and vigorous, thus indicating how well adapted they are. The species that are to be introduced, therefore, must be given all cultural advantages possible over the potential reinvasion of the hardy woody plants.

In the western United States, areas seeded to perennial grasses should have at least one full year, and in many instances two years, of total protection before grazing is allowed. Rodents should be poisoned where numerous, and, if possible, heavy invasions of weeds should be mowed in early summer or sprayed with a selective herbicide.

Satisfactory distribution of livestock over the range is of great importance in order to avoid spotty overgrazing and undergrazing. On cattle range this can be done by salting away from the water, development of watering places remote from meadows and other favorite units, and by fencing to prevent drifting and better control of the animals. On open sheep range the herder should so direct the flock that the grazing pressure is properly distributed.

One of the cardinal principles of range management is that of determining and applying the proper season of use. The opening date for grazing should be delayed until growth is far enough along to afford a "good bite," and until the soil has become firm. Generally the grass leaves should be 3 to 5 inches (8 to 13 cm.) in length and all the free gravitational water should be drained away. A close relation exists between seasons of use and numbers of livestock grazed, for grazing capacity is determined in terms of total animal months use. Range that extends into different life zones should be grazed on a seasonal zonal basis. The earliest units should be grazed first, followed by the next higher elevational zone.

Harvesting of the forage crop should be conservative. Too close grazing ultimately leads to reduced forage yield and loss of soil fertility. Appraisal of range utilization, once a proper standard of use has been established for a given area, can be made by estimation, by measurement, or by a combination of these.

Most perennial ranges are properly stocked when about 50 percent of the year's growth is left on the ground at the end of the grazing season. This would be roughly equivalent to a stubble height of 4 to 5 inches (10 to 13 cm.) for the tall grass type composed of plants like the wheatgrasses, fescues, and bromes, and 1 ½ to 2 inches (4 to 5 cm.) for the short grass type, as for blue grama and buffalo grass.

Generally range utilization is uneven because of differences in preference of livestock for the various species. For practical reasons, the degree of utilization is based on so-called "key" species, or some two or three kinds of plants that provide most of the forage. When the key plants are properly utilized — as at the end of the grazing season — the range as a whole is also assumed to be properly grazed (*39*).

One complication in proper stocking is that forage production may fluctuate widely from year to year because of differences in precipitation and temperature. Accordingly, stocking rate should be based on production between the average and the poorest years. The question of stocking must be settled for each individual ranch or administrative unit as local conditions and experience would indicate.

The Role of Research in Land Clearing

The recognized importance of brush control over large areas of the western and southern United States has been instrumental in initiating extensive research and practical control trials during the past 15 years. The studies have engaged the talents of mechanical engineers, chemists, ecologists and physiologists, agronomists, animal husbandmen, range and wildlife managers, foresters and economists.

There is much to be learned from the work which has been done in the United States and elsewhere, much of which can be applied to other regions of the world. On the other hand, it is well to recognize that each region of the world has its peculiarities and some specific research will need to be carried on within each region. Much of this will need to be done by governments or well-financed institutions with the co-operation of industry. Future research will no doubt best be continued in this co-operative manner.

Appendix – *Comparative effectiveness, cost and other attributes of brush control methods in five distinct vegetation types*

Table 1. – Eradication of Big Sagebrush in Western United States (27)

Operation	Percentage kill	Other effects	Adaptability to terrain	Ease of seeding after treatment	Availability of equipment	Cost of control[1]
Discing	70-90 % of old; slightly less of young	Kills all other vegetation except sprouting shrubs; mulches stems and prepares seedbed	Limited to little or no rock except with brushland plow	Suitable for drilling; seedbed may be loose	Most plows & discs commercially available; the brushland plow must be custom made	$3 to $5 per acre
Railing	30-80 % of old; 15-30 % of young, flexible	Damage slight except for pedestaled bunchgrasses and non-sprouting shrubs	Limited to level or uniform slopes with no protruding boulders	Not easily drilled unless piles of brush are burned. Rails cover broadcast seeding poorly	Not commercially available; can easily be built in farm shop	$0.50 to $1 per acre one-way on large tracts
Harrowing	30-70 % of old, brittle; 10-30 % of young, flexible	Does not affect sprouting shrubs or annual vegetation; uproots 10-20 % bunch-grasses	Primarily suited to rocky ground and rough terrain	Drilling difficult. Seeding ahead of harrowing covers well	Not commercially available; can easily be built in farm shop	$3 to $5 per acre
Beating	50-90 % of old; 30-60 % of young, flexible	Little damage to herbs, grasses, or non-sprouting shrubs	Limited to rock-free or slightly rocky sites	Can be drilled unless brush is heavy; broadcasting before beating has been successful	Commercially available	$3 to $8 per acre
Grubbing	90-99 % for all age classes	Kills most other shrubs; bunch-grasses killed except when cut deep but then shrubs are not killed either. Rhizomatous grasses undamaged	Limited to level and rock-free areas	Some clearing is necessary before drilling is possible. Broadcast seeding not advised without packing soil	Commercially available	Approximately $6 per acre
Controlled burning	95-100 % of all ages	Kills non-sprouting shrubs and less than 30 % of grass; sprouting shrubs not affected much	No limit except as imposed by fire danger and erosion hazard	Can be drilled or broadcast easily. Seedbed is firm. Ashes are beneficial to seedling growth	Technical assistance or experience needed; equipment is generally available	$0.50 to $2.00 per acre on tracts over 1,000 acres
Spraying	70-95 % of large, old; less of young	Kills weeds as well as many palatable forbs. Grasses unharmed. Other brush plants not seriously affected	Unlimited by air or ground	Dead brush remains standing and must be removed before drilling; air broadcasting feasible	Equipment and chemicals commercially available	$3 to $6 per acre

[1] 1 acre = 0.4047 hectare. The cost per hectare is, therefore, approximately two-and-a-half times greater.

TABLE 2. – CONTROL OF CHAPARRAL IN CALIFORNIA (*6*)

Operation	Percentage kill	Other effects	Adaptability to terrain	Ease of seeding after treatment	Availability of equipment	Cost of control[1]
Bulldozing (windrowing)	95-100 % top kill is possible where terrain permits	Does not prevent sprouting; windrows hinder subsequent management unless burned	Limited to level or moderate slopes where erosion hazard is low	Broadcast seeding only. Windrows are obstacles	Commercially available	$10 to $20 per acre
Bulldozing (mashing)	95-100 % top kill	Does not prevent sprouting; mashed brush is easily burned or it may be left as mulch if not too thick	Less restricted to gradual slopes than windrowing method	Broadcast seeding only; much litter on ground	Commercially available	$10 per acre
Discing		Breaks up woody stems and uproots many shallowly rooted sprouts. Infiltration enhanced	Limited to gently sloping land or very short steep slopes. Excellent for ridgetops	Broadcast seeding only; too many stems and stumps remain intact	Commercially available	$5 to $7 per acre
Double-discing		Besides above, good seedbed prepared	Same as above. Both should be done on contour	Drilling may be possible in certain places	Commercially available	$10 to $12 per acre
Controlled burning (conventional)	0-95 % top kill. Variable due to weather conditions	Seldom kills much more than 50 percent of sprouting species. Difficult to keep out steep slopes that should remain in brush. Most seeds remain viable	No limit. Hazardous areas should be excluded if possible	Broadcast seeding by air or on horseback. Seed coverage impossible	Permit required. Cooperation of landowners and state agencies necessary	$0.40 to $3.65 per acre (see Fig. 50)
Controlled burning (area ignition)	Up to 100 % top kills. Many more plants are completely killed than with conventional method	Heat intense enough to kill all plants. Some sprouting will take place. Higher proportion of seeds scorched	Limited to terrain where bulldozer can operate	Burn is clean enough to make uniform seed distribution possible from ground. Seed can be covered with drag	Bulldozers available. Technical assistance is most important item	$2.50 to $10 per acre for mashing (see Table 1)
Aircraft spraying with 2-4, D	Variable, depending on species	No effect on grasses; one application does not prevent sprouting; seedlings very susceptible	No limit, except canyons where drafts make it too dangerous to fly. Spray drift is biggest problem	Seedbed not suitable after chemical treatment	Chemicals are available; planes may be scarce during crop dusting period. Helicopters less generally available	$3 to $6 per acre (fixed-wing plane) $5.50 to $8.50 per acre (helicopter)

[1] 1 acre = 0.4047 hectare. The cost per hectare is, therefore, approximately two-and-a-half times greater.

TABLE 3. – ERADICATION OF MESQUITE IN TEXAS AND SOUTHWESTERN UNITED STATES (2)

Operation	Percentage kill	Other effects	Adaptability to terrain	Ease of seeding after treatment	Availability of equipment	Cost of control[1]
Hand grubbing	85 %	Eradication can be confined entirely to mesquite bushes	No limits	Inadequate seedbed preparation	All tools are available	$20 to $32 per acre
Kerosene basin	92 %	Kills all herbaceous vegetation a foot or more from base	No limits	No seedbed prepared; brush still standing after treatment	Kerosene and cans cheap and available	$13 to $18 per acre
Kerosene pour	76 %	Small circle immediately around base has no herbaceous cover	No limits	No seedbed; brush still standing	All materials available	$4 to $14 per acre
Aerial spray of 2, 4,5-T		Aids in control of herbaceous weeds; does not affect grass	No limit. Mesquite ranges are ideally suited for aerial treatment	Standing brush is greatest obstacle	Commercially available	$3 to $4 per acre
Chaining		Takes out most of old, brittle brush; no effect on grasses	Limited to fairly level wide expanses	No special seedbed preparation; chains are good for covering seed	Commercially available	$2.50 to $3.00 per acre
Machine grubbing		Many young plants remain	No limit, except on steep slopes	Loose seedbed prepared	Commercially available	$10 to $15 per acre
Rootcutter	63 %	Digs up soil and other plants. No erosion hazard on most mesquite ranges	Limited to level or slightly sloping land	Seedbed is loose and covered with uprooted plants	Commercially available	$3.50 to $6.00 per acre

[1] 1 acre = 0.4047 hectare. The cost per hectare, is therefore, two-and half limes greater.

TABLE 4. - ELIMINATING HARDWOOD CULL TREES FROM WOODLAND IN CENTRAL UNITED STATES (*2*)

Operation	Percentage kill	Adaptability to terrain	Suitability for seeding	Availability of equipment	Cost of control (U.S.$)
Basal spray [1]	100 %	No limit	Not seeded	No special equipment needed. Hand sprayer, oilcan or paint brush can be used	Labor: $0.0010D^2 + 0.0042$ Solution: 0.0135D Total: 0.0145D + 0.004
Frill method	100 %	No limit	Not seeded	Axe and oilcan needed	Labor: 0.0015D + 0.0049 Solution: 0.0050D Total: 0.0065D + 0.005
Cornell tool	61-72 %	No limit	Not seeded	Cornell tool available or can be made in shop	Labor: 0.0028D - 0.0007 Solution: 0.0009D Total: 0.037D - 0.001

[1] Chemical used was kerosene solution of 2, 4, 5-T containing 1⅛ lb. (7 kg.) acid equivalent per 100 gallons (455 liters) of solution.
[2] D stands for diameter breast high. Thus for a 10-inch (25 cm.) tree, labor cost for basal spray is $0.01 + $0.004 and total cost is 14½ or 15 cents.

TABLE 5. – LAND CLEARING OF HAMMOCKS [1] AND FLATLANDS IN FLORIDA (*5, 16*)

Operation	Percentage kill	Other effects	Detailed description of vegetation	Hours per acre		Cost of control [2]
Tree cutter [3] Rock rake Bush and bog harrow	Cleared adequately for pasture establishment	Underground stumps and root systems left in ground	105 trees per acre: oaks, magnolia, gums, maple, also palmetto. Trees varied from 6-24 in. (15-61 cm.) d.b.h.	Tree cutter: Rock rake: Bush and bog harrow:	0.95 1.23 0.61	$41.67 per acre [4]
Detachable stumper Rock rake Bush and bog harrow	Cleared thoroughly enough for cultivated crops	Holes 10 feet (3 m.) in diameter and several feet deep were left by removal of large trees	108 trees and stumps per acre: oaks, magnolia, gums, maple, and chest-high palmetto. Stumps and trees varied from 6-24 in. (15-61 cm.) d.b.h.	Detachable stumper: Rock rake: Bush and bog harrow:	1.06 1.77 0.66	$52.32 per acre
Rock rake Detachable stumper Rolling chopper	Debris chopped and land leveled for cultivated crops	Good layer of mulch on soil	116 stems per acre, including 7 very large trees and 17 stumps. Species vere live oak, water oak, cherry, dogwood, vines, and palmetto	Rock rake: Detachable stumper: Rolling chopper:	3.55 0.35 0.24	$60.56 per acre
Rock rake Detachable stumper Bush and bog harrow	Completely cleared	None	Heavy hammock with oaks, magnolia, dogwood, large vines and palmetto. Average of 88 trees per acre cleared and piled with rake and 7 with stumper	Rock rake: Detachable stumper: Bush and bog harrow:	4.17 0.54 0.40	$76.47 per acre
Detachable stumper Rock rake Undercutting plow	Cleared adequately for pasture establishment	Soil loosened bay plow	Palmetto flatwoods: heavy growth of palmetto 5-6 feet (1.5-1.8 m.) tall; green pine trees and stumps with heavy tap roots. About 60 stems per acre	Detachable stumper: Rock rake: Undercutting plow:	0.82 1.29 0.40	$31.03 per acre

[1] In the southern United States, a piece of rich land with hardwood trees growing on it.
[2] 1 acre = 0.4047 hectare. The cost per hectare is, therefore, approximately two-and-a-half times greater.
[3] All equipment attached to 155 hp. tractor.
[4] Based on tractor rental of $15.00 per hour.

Commodity Report

China's Rising Paper Output

To Tsai Lun, who lived in China in the second century A. D., is generally credited the invention of paper. But there are earlier references to paper-making in Chinese annals. More than a century before Tsai Lun, there is mention of the production of paper, for wrapping and for writing, prepared by women who mashed the waste from silkworm cocoons, spreading and drying the pulp so obtained so as to form thin sheets. This paper was highly prized and in great demand; not unnaturally, having regard to the raw material, it was expensive.

It was in A. D. 105 that Tsai Lun, a high court official concerned with supplies for the Imperial Court, invented a paper made from hemp fibre, rags and old fishing nets. The cheaper raw materials made paper-making possible on a larger scale, and handicraft production of paper began to develop rapidly. Thus, for the first but by no means the last time in the history of paper making, the pressure of demand on limited traditional sources of raw materials produced a technical revolution. The Chinese people have made and used paper ever since, and have developed some of the world's finest handmade papers. Bamboo, which today accounts for about half of all the raw material supplies for China's paper industry, was first used in the third century. Woodcuts surviving from about the year 1640 show the successive stages of the paper-making process during the Ming dynasty. First the bamboo slips are cut and washed. The bamboo "chips" are next boiled in a tank with water to make pulp. Shallow bamboo screen paper molds are then filled with pulp. The damp paper is pressed with a bamboo screen, and finally the sheets of paper are dried over a wood-fired oven.

The handicraft paper industry has expanded considerably in recent years, and makes an important contribution to China's paper supplies. In 1952, it accounted for no less than 32 percent of total production and was planned, in the final year of the current five-year plan (1953-57), to reach 237 thousand metric tons, or 26 percent of total production. Thus China has easily the most important handicraft paper industry in the world today.

Machine-made paper in China dates back little more than half a century. The first modern paper mills were not set up until the end of the nineteenth century. These were established with imported machinery and relied largely on imported pulp for their operation. However, the industry had a chequered career up to the outbreak of the Sino-Japanese war. It was technically backward and poorly equipped, and found difficulty in competing with the imported product. Considerable quantities of paper were imported; in the peak prewar year, for example, no less than 70 thousand tons of newsprint reached China from foreign sources. Nevertheless, with nine-tenths of the population illiterate, per capita consumption of all types of paper never exceeded half a kilogram in prewar times.

The cutting off of foreign paper supplies during the war with Japan brought about a certain revival of the handmade industry, and during these years most newpapers, books and magazines were printed on handmade paper. With the end of the Japanese war, foreign imports started to flow in again, adversely affecting the national paper industry. Production fell further during the civil war and by its end in 1949 most of China's paper mills were out of operation. Faced with urgent paper needs, and very limited possibilities of obtaining foreign supplies, the new regime attacked the problems of rehabilitating existing mills and reviving the handicraft industry. Thus the Tsientsin State paper mill, started by the Japanese in 1939, was by 1952 producing three times the average annual output attained under the Occupation. Also in the northeast, the Kirin State paper mill, whose daily output had fallen to 20 tons, was re-equipped and daily output raised to 150 tons. In the south, at the Canton State paper mill, the machinery which had been removed by the Japanese was recovered and re-installed, and by the beginning of 1951 newsprint was again being produced at this mill. In all, by early 1954, 12 paper mills had been reconstructed, including several privately-owned mills, as, for example, the Kongmoon mill in Kwantung province, where new Kamyr type pulping machinery was installed.

During the first phase, efforts were thus concentrated on rehabilitating existing mills and taking measures to ensure maximum output from existing capacity. At the same time, close attention was given to the handicraft industry, which offered the possibility of a useful increase in output without heavy capital investment. Moreover, it furnished employment in an underemployed economy. The rising demand for paper, too, provided favorable market conditions for an expansion. Published figures reveal a sharp rise in the tonnage of paper handled by State trading agencies.

Meanwhile, steps were being taken to lay the basis for a further expansion of machine-made capacity, and to create a native pulp and paper machinery industry.

Two recently opened State paper mills, in Kiangsi and Hupeh provinces respectively, are reported to be entirely equipped with machines manufactured in China. The centers of the pulp and paper machinery

industry are Tientsin and Shanghai; and grinders, digesters, filters and bleaching tanks figure among the items being produced.

The most important capital project, however, is being fitted with Soviet equipment, with assistance from Soviet technicians. This is believed to be one of the 156 major projects forming the backbone of the five-year plan, where Soviet help includes site surveys, designs, installation, training of personnel and help in initial operations. This new mill is located at Kiamusze in northeast China. Due for completion this year, it will draw its wood from neighboring forests and coal supplies from the nearby Hokang mines. It includes a large sulphate pulp mill and its production program includes industrial papers, kraft wrappings and bag papers, electrical insulating papers, etc., and 10 thousand tons of market pulp.

Altogether, the 1953-57 plan provides for an increase in annual capacity in the machine-made paper industry of 186,000 tons, of which 40,000 tons had been completed by the end of 1955 and 95,000 tons are expected to be in commission by the end of 1957. This latter figure corresponds to 7 out of the 10 new mills projected. These figures evidently relate only to the new mills, and do not take account of further improvements and new installations designed to raise output at existing mills, since they are some way below the increase in paper and board output provided for in the plan.

Table 1 indicates how rapidly paper production has expanded in recent years. Machine-made paper is one of the industries which has succeeded in exceeding the production figures laid down in the five-year plan. Thus the goal originally set for 1957 has now been revised upwards from 655 thousand tons to 800 thousand tons. In accordance with the revised plan was aimed to produce 710 thousand tons in 1956. It has been stated that the original plan for 1957 included 154 thousand tons of newsprint; no details of actual newsprint output are available.

Thus, taking into account the output of the handicraft industry, it would seem that; in 1957, total paper production will top the million ton mark for the first time. Production in 1956 was sufficient to permit a per capita consumption of 1.5 kilograms. This, though three times that of prewar, is still among the lowest in the world. A further substantial expansion will certainly be provided for in the next planning period. The figure, mentioned for machine-made paper in the proposals which are shortly to be submitted to the State Council for the second five-year plan (1958-1962), is 1,500 to 1,600 thousand tons.

One of China's principal problems is raw material. China is lacking in forests and, though new reserves have been brought to light in recent years, they are mostly in inaccessible areas [1]; the northeast remains, as it was in prewar days, the principal center for forest industries. Wood pulp was produced there on a large scale during the Japanese Occupation, but most of it was shipped to Japan for her rayon industry. Though a further development of the wood pulp industry is now taking place in this area, elsewhere in China the pressure on forest resources for timber for constructional and other purposes makes the search for alternative materials imperative [2].

The handicraft industry makes use primarily of bamboo but also of rice straw. In the machine-made industry, too, bamboo is an important material; indeed it is reported that experiments carried out by a Soviet expert, N. Z. Veretchin, have led to the production of newsprint with a furnish of mechanical bamboo pulp combined with 40 percent chemical wood pulp. To Veretchin also is credited the introduction of semi-chemical rice straw pulp. This went into large-scale production in 1952 at the Peking State paper mill and the process was subsequently widely adopted. In southwest China, bagasse has been used for some time to produce board. Today, fine papers, said to be inexpensive and of high quality, are being made from bagasse, a development which is also attributed to successful experiments carried out by Veretchin. The process, which is not described in full, is reported not to require the removal of the pith.

TABLE 1. – PAPER PRODUCTION IN CHINA (MAINLAND) 1943 – 1957

Period	Machine-made	Hand made	Total
	..... *in thousand metric tons*		
Prewar (1943)	165	*75*	*240*
1949	105	*45*	*150*
1950	150	*80*	*230*
1951	250	*120*	*370*
1952	372	167	539
1953	425	*180*	*605*
1954	556	*195*	*751*
1955	589	*210*	*799*
1956 Revised plan	710	*225*	*935*
1957 Original plan	655	237	892
Revised plan	800	*240*	1 040

NOTE: The figures in standard type are either published or derived from published percentages. All other figures are secretariat estimates.

SOURCES: *For machine-made paper:* Annual communiques of the State Statistical Bureau on Plan Fulfilment, and annual reports on the State budget. Also LI FU CHUN: *Report on the First Five-Year Plan for the Development of the National Economy;* CHOU EN-LAI: *Report on Proposals for Second Five-Year Plan;* and RONALD HSIA: *Economic Planning in Communist China,* Institute of Pacific Relations, 1955.

[1] For example, 2 million hectares of forest land in Inner Mongolia are currently being surveyed, aerial photography being combined with ground investigations, while substantial spruce, poplar and birch forests have been discovered in the Tienshan Mountain range in Sinkiang.

[2] Though it should be noted that in some areas new transport developments in conjunction with rising coal output have sharply lowered the cost of coal, thus releasing for industrial purposes wood formerly used as fuel.

Apart from the raw materials which have been mentioned, efforts are being made to step up the salvage of rags and waste paper. Li Fu-Chun, in his report on the first five-year plan, drew attention to the need for practising strict economy and pointed to the gains which could be secured, independently of capacity increase, through more effective measures to reduce waste.

Little is known about China's supplies of other materials for pulp and paper-making, but it is reported that the old-established Yungli plant in Hopei province — a joint State and privately-owned enterprise — has been greatly expanded in recent years; this plant is the principal supplier of soda-ash to China's pulp and paper industry.

An energetic campaign to reduce illiteracy is being waged in China, and no doubt the language reforms (the introduction of simplified characters, and the declared intention to work towards phoneticizing the language) will accelerate progress.[3] Rising literacy and advancing industrialization render certain a continued growth in the country's paper needs. Will the planned expansion succeed in satisfying these needs? It is difficult to say. Certainly China continues to import paper. Exports from Finland to China in 1955 totalled 22 thousand tons, including 9.5 thousand tons of newsprint, more than double the corresponding figure for 1954. China also imports smaller quantities from other European exporting countries, either directly or through Hong Kong. What is notable, however, is that China has already become an exporter of paper, notably of newsprint, on a by no means negligible scale. Thus newsprint exports (which it is understood are being shipped from the recently expanded Kwantung mill) figure in recent trade agreements with Ceylon, Burma and Indonesia. It is reported that total newsprint exports from China reached 32 thousand tons in 1955, against 4.5 thousand tons in 1954. The political and economic importance of this recent development will not be overlooked.

China, the birthplace of paper, is already second only to Japan among the world's producers outside Europe, North America and the U.S.S.R. Though domestic requirements are soaring, there is no doubt that the planning authorities are not oblivious to the rising needs of a paper-hungry Asia. The achievement of a substantial increase of output in the face of a serious lack of those papermaking materials traditional in the West, should not go unobserved.

J.C.W.

[3] The five-year plan provides for the following percentage increases in enrolments by 1957 as compared with 1952: higher educational institutions, 127; senior middle schools, 178; junior middle schools, 79; primary schools, 18. The last figure implies that, by 1957, just over 60 million pupils, or 70 percent of the country's school-age children, will be attending primary schools.

THE NEW SWEDISH NATIONAL FOREST SURVEY

Concluded from page 8.

A party consists of six or seven men, including a crew leader who has been trained in a forestry school or in the college of forestry, a foreman, a compass man, in some cases a separate caliper-man, two chain-men and a combined cook and chauffeur.

Costs

The total costs for the new national forest survey are estimated at about 450,000 Swedish krone (about of U.S.$ 87,000) yearly, or 2 öre (U.S.$ 0.04) per hectare forest land, i.e. 20 öre (U.S.$ 0.004) per hectare of forest land for the whole survey cycle. About 55 percent of the total amount is allotted to field work, and 45 percent to office work, which, in addition to the regular tasks described above, also includes a variety of special investigations and calculations.

Value of the New Survey Method

It may naturally be asked whether the National Forest Survey has really been improved by the new method, since after two years' surveying it is only possible to present the somewhat general results given above. In earlier inventories a detailed account of forest conditions could be given at the end of each year for one or two provinces. It must be borne in mind, however, that the new type of survey already affords a complete picture of the timber situation in the whole country at the end of one or two years; the older types could only give the corresponding figures after the completion of the survey cycle, and furthermore these figures were obtained from the results for provinces surveyed at different times. Moreover, the full effect of the new form of survey will not become apparent until the results for regions and provinces are available after a certain number of years; consecutive annual reports for such districts will then be obtained instead.

Again, apart from the growing stock, the new survey also gives data relating to annual growth and drain. The figures for the annual drain form the basis of the yearly felling statistics for the whole country. By this means an old statistical problem, which has been troubling authorities and experts for many decades, has found a satisfactory solution. This applies to the total cut which can now be expressed in " forest cubic volume " (i. e., total stem volume of standing trees). This solution was only rendered possible by organizing the national forest survey on the new lines.

The new type of survey will thus provide the means for a continuous control of the timber situation in the country in a far more satisfactory manner than hitherto, and must therefore be regarded as a progressive step in the field of timber statistics.

The Work of FAO

Silviculture Study Tour in Czechoslovakia

A study tour conducted under the Technical Assistance Program on the silviculture and management of pure and mixed forests opened in Prague on 2 July and closed on 17 August 1956. 35 participants from 20 countries, including many from Asia and Latin America, took part in the tour and technical discussions, as well as 40 representatives of Czechoslovakian forest administration and research.

The object of the tour was to study the problem of the silviculture of pure and mixed forests, the consequences of monoculture and measures to prevent and correct the bad effects of such monocultures. The problem of retarded growth of second and third generations of pure spruce forests, development of heavily podsolized, unhealthy soils under them, and the concurrence of serious disease, insect and climatic injuries in such forests, is common to a number of European countries where for the past two centuries, spruce had been planted on sites where spruce did not occur naturally. A similar problem faces countries in other regions developing planting programs of pure species.

The forests of Czechoslovakia, with their interesting history dating back to the early 18th century and in some cases to the middle 17th century, and their many examples of 35- to 40-year-old efforts mainly in Bohemia and Moravia to correct the obvious bad consequences of monocultures on " off-site " forests, provides an excellent laboratory to observe and discuss the problem, its remedies and prevention. The participants discussed with interest how this problem related to conditions in their own countries. The European foresters, particularly those from Austria, France, Germany, Switzerland and Yugoslavia, had much to offer as to remedial possibilities with emphasis on the economic aspects. The discussions drove home the point, so important in planning reforestation programs, of choosing the proper species for each available soil and climatic condition. This was of great value, as expressed by the participants from Latin America and Asia, to countries now engaged in initiating or expanding their forest planting work. The importance of careful research into the ecology of natural forests, field trials of exotic as well as native species, the study of the effects of such silvicultural methods as early and frequent thinnings, cleanings, use of nurse trees and ameliorating broadleaved species, and particularly various methods of obtaining natural regeneration, was stressed throughout the tour.

Prof. H. Leibundgut, Director of the Institute of Silviculture at the *Technische Hochschule* at Zürich, served as FAO co-director of the tour and Dr. K. Cermak, Director of the Czechoslovakian Forest Research Institute, acted as co-director on behalf of the Czechoslovak Government. M. A. Huberman represented the Forestry Division of FAO.

A detailed report of the tour has been prepared containing the discussions, the reports of working groups and the country papers which were submitted by most of the participants prior to the tour.

Watershed Management in Yugoslavia

Under the chairmanship of J. Messines, of France, the Working Party of the European Forestry Commission on Torrent Control and Protection from Avalanches, held a third session and study tour from 29 July to 10 August in Yugoslavia.

Erosion control works in high mountain areas were inspected in the Republics of Serbia, Bosnia-Herzegovina, Croatia and Slovenia, while at the technical meetings, discussions took place on the protection against sedimentation of large reservoirs. In many countries, sufficient attention is still not paid to erosion control in upper watersheds in relation to other protection works, and the working party recommended that before large public works are undertaken for irrigation and hydroelectric power, governments should always consult the services responsible for soil conservation and watershed management. It also recommended that, co-ordinated by the International Union of Forest Research Organizations (IUFRO), further research be undertaken to obtain data on the influence of various kinds of vegetative cover on the water regime, the efficiency of the various techniques for the correction of torrents and the utilization, conservation and restoration of soils and other related matters. In this connection, it is to be noted that the program of work of the Forestry Division envisages the publication in 1957 of a basic study on " forest influences ".

On the general subject of conservation and utilization of soils in high mountains, it was agreed that stable soils and unstable soils must in many cases be treated quite differently and that in many instances the latter are not capable of withstanding any disturbance of the vegetative cover. Soil conservation practices recommended, included reforestation and revegetation with the aid of banquettes and other methods of increasing infiltration of water into soils. An interesting point was a recommendation that plants having aromatic or medicinal values be considered for use in revegetation because of their economic value.

The report of the Working Party will be available shortly. It will be referred to the full European Forestry Commission next May for endorsement.

Member countries represented were Austria, Belgium, France, Germany, Italy, Norway, Switzerland, Turkey and Yugoslavia. At the invitation of the Yugoslav

Government observers also attended from Romania and the Union of Soviet Socialist Republics. T. François, Chief of the Forest Policy Branch, Forestry Division, represented the Director-General of FAO and served as secretary; other FAO staff members present were Clark S. Knight, of the Forestry Division, and John Blackmore, of the Agriculture Division.

ECE Timber Committee

The ECE Timber Committee, which is serviced by a joint ECE and FAO staff, held its fourteenth session in October 1956. Record participation included for the first time delegations from Byelorussia, Portugal and Spain.

The Committee noted a distinct weakening in the sawn softwood market in 1956, with a sharp drop in the volume of European trade. This weakening was most pronounced in the United Kingdom and the northern countries, less marked in continental western Europe, while in central and eastern Europe — notably [illegible] — the demand remained strong enough to absorb the supplies available.

The lower volume of trade sprang primarily from stock liquidation compelled by tighter credit; consumption [illegible]

Import requirements in 1957 were expected to be slightly up on the current year. Export prospects were slightly down, with reductions in Finland, Sweden and Austria, and maintained export availabilities in the U.S.S.R. and eastern Europe. Canadian exports, sharply down in 1956, might recover should European demand so warrant. The Committee concluded that prospective supplies were reasonably well in balance with export requirements and that, provided no serious recession in consumptional and industrial activity intervened, stable conditions should prevail in the European sawn softwood market in 1957. So far as small-sized roundwood was concerned, supply and demand for 1957 appeared to be better matched than in recent years.

Following the consideration of the pulpwood market, the Committee heard a Secretariat statement drawing attention to certain changes which had occurred in recent years in the continent's net trade balance in pulp and paper. It requested the Secretariat to circulate to delegates for their information a note setting out the points made.

An innovation at this session was a survey of the European sawn hardwood market, with particular reference to oak and beech. Oak and beech sawnwood production and trade now play an important part in the timber economies of many countries, and the Committee requested the Secretariat to undertake regular appraisal of the sawn hardwood market and to maintain this item on the Committee's agenda.

The Committee expressed satisfaction with the first draft of a study of trends in the utilization of wood and its products in housing, and requested the Secretariat to prepare a final version of this study; delegates undertook to supply the necessary material. The Committee also requested the Secretariat to give priority to further sector studies, suggesting that precedence be given to a study of trends in the utilization of wood in packaging.

Seven countries took part in private meetings arranged at the request of certain delegations to discuss special import export problems arising between them. Positive results flowing from similar contacts established at the thirteenth session were reported.

The Committee received a report on the work of the Joint ECE FAO Working Party on Forestry Statistics, and decided that this working party should continue in existence until it had completed consideration of the problems allotted to it. The Committee also noted with satisfaction the progress made by its Working Party on the Standardization of General Conditions of Sale for Timber and by the Joint ECE FAO Committee on Forest Working Techniques and Training of Forest Workers.

Finally, the Committee closely reviewed its program of work and made a number of changes designed to concentrate efforts and establish priority. It pressed for a practical start on a project concerned with the collection, transport and utilization of forest and sawmill waste.

World Eucalyptus Conference

During the period 17-30 October 1956 some 90 participants from 26 countries gathered at FAO Headquarters to discuss the numerous problems of growing and utilizing eucalypts.

Among the discussion papers presented either by the author or by another speaker were the following:

1. *The Value of Eucalypts*

"World-wide, particularly Australia"	D.A.N. Cromer, Australia
"Mediterranean countries"	A. Métro, France
"Tropical Africa"	R. Pierlot, Belgian Congo
"East Africa"	A. L. Griffith, East Africa
"Latin America"	C. M. Flinta, Argentina
"Asia"	Sukhum Thirawat, Thailand
"Eucalyptus trees in the United States"	Woodbridge Metcalf U.S.A.

2. *Problems Basic to Planting*

"Round-up of research in the past five years and future needs"	A. Métro, France
"Ecology-standard site descriptions"	A. de Philippis, Italy
"Dendrology and identification"	N. Hall, Australia

" Site-species trials "	J. Elorrieta, Spain
" Eucalyptus genetics "	L. D. Pryor, Australia

3. *Establishment, Management and Protection of Eucalyptus*

" Round-up of successful methods and research needs "	A. Y. Goor, Israel
" Nursery and planting techniques "	E. da Silva Reis Goes, Portugal
" Background factors influencing the occurrence and treatment of Eucalypt woodland in Australia "	M. R. Jacobs, Australia
" Thinnings and regeneration "	FAO Staff
" Yields and rotations "	FAO Staff
" Protection "	G. W. Chapman, FAO Forestry Adviser Iraq

4. *Protection for Farming and Soil Stabilization*

" Round-up of successful methods and research needs "	A. de Philippis, Italy
" Eucalypts in the protection of agriculture "	R. Karschon, Israel
" Soil stabilization "	A. Monjauze, Algeria

5. *Utilization*

" Round-up of industrial uses and research needs, including obstacles to wider use "	S. A. Clarke, Australia
Commentaries on above:	G. Giordano, Italy; C. H. Banks, Union of South Africa; and F. Nájera, Spain
" Physical and mechanical properties "	J. D. Boyd and R.S.T. Kingston, Australia
" Sawmilling, machining, peeling, grading and utilization of residues "	R. F. Turnbull, Australia
" Seasoning "	G. W. Wright, Australia
" Durability of eucalypt timbers and their preservative treatment "	N. Tamblyn, Australia
" Chemical utilization "	H. E. Dadswell and R. C. McK. Stewart, Australia

Following discussion in plenary session under the chairmanship of Mr. G. J. Rodger, Director-General, Commonwealth Forestry and Timber Bureau, Australia, four working parties were created under the leadership of A. Métro, A. Y. Goor, A. de Philippis, and S. A. Clarke, to examine in detail the topics 2 to 5 respectively listed above.

The highlights of the discussion and the recommendations of each working party were incorporated into the final report, which was adopted by the Conference at its closing meeting on 23 October. As regards the organization of future work with eucalypts, the Conference recommended that:

(*a*) FAO's Regional Forestry Commissions should set up working parties on the model of that created by the Mediterranean Subcommission;

(*b*) Interested Member Governments should set up national working teams consisting of representatives of the sectors concerned, from production to consumption, or appoint permanent correspondents to the regional working parties;

(*c*) The Director-General of FAO should ensure the co-ordination of the work of the various regional parties, and eventually organize another world conference after a certain lapse of time.

In view of the importance of eucalypts in tropical zones and the difficulties encountered in their utilization, the Conference requested the Director-General of FAO to examine the possibility of organizing a Working Party on Eucalypts for Tropical Africa, in consultation with other appropriate organizations such as the Commission for Technical Co-operation in Africa South of the Sahara (CCTA).

A representative of Spain extended an invitation to hold a future World Eucalyptus Conference in that country, while the representative of Brazil expressed his country's desire also to serve as host for a forthcoming conference.

The officers of the Conference were, in addition to the chairman, Mr. G. J. Rodger; vice-chairmen: Professor Pavari, Director of the Forest Research Institute, Florence, Italy, and Mr. A. Navarro Sampaio, Brazil. Rapporteur, Dr. H. F. Mooney, United Kingdom.

An annex to the final report of the Conference lists 30 country reports which were submitted by Member Governments, with some 20 bibliographies. Copies can be requested direct from the originating authors or governments.

From 24-30 October, a study tour organized by the Italian Government took the participants through the eucalyptus plantations of the *Società Terra Apuliae* in the provinces of Foggia and Matera, and to nursery and planting operations in several parts of Sicily, principally in the vicinity of Piazza Armerina and Catania. Prior to this tour visits had been made to eucalypt planting work in the vicinity of Tivoli, the shelterbelts in the Agro Pontino, and the interesting experimental fields and laboratories of the *Ente Nazionale per la Cellulosa e la Carta*.

Shelterbelts and Arid-Zone Forestry in the U.S.S.R.

Under the United Nations Technical Assistance Program, FAO made arrangements in 1956 with the Ministry of Agriculture of the U.S.S.R., to hold a seminar followed by a study tour on forestry problems, particularly the role of forests, tree planting and shelterbelts in the utilization and protection of semi-arid and arid zone soils. D. T. Kovalin, Chief Forester, and K. Z. Gubaidullin, Forest-Inspector for Central Asia, both of the U.S.S.R. Ministry of Agriculture, acted as chief adviser and co-director, respectively, and A. Métro, Conservator of Forests, France, was appointed co-director for FAO. T. François and M. Andersen represented FAO and its Forestry Division.

Twenty-four participants, most of them occupying senior positions in their national forest services, were nominated by their governments, as follows: Chile, 1; Egypt, 1; France (overseas), 2; India, 1; Iran, 2; Israel, 2; Lebanon, 1; Pakistan, 1; Peru, 1; Sudan, 2; Tunisia, 2; Yugoslavia, 3, and the U.S.S.R., 5.

The seminar was conducted in Moscow, opening on 21 August in the presence of Mr. Petrov, Vice-Minister of Agriculture. The following lectures were given:

"Forest and forest management in the U.S.S.R."	V. T. Tseplyaev
"Protective afforestation"	G. I. Makyakin
"Irrigated afforestation"	K. Z. Gubaidullin
"Afforestation on sands in the European part of the U.S.S.R."	I. S. Matiuk
"Erosion control in flat-country regions of U.S.S.R."	I. D. Braude
"Forest seeds and raising planting stock"	D. P. Ishin
"Designing and land survey in land and forest reclamation in the U.S.S.R."	N. A. Nagovitsyn
"Mechanization of work in forest shelterbelts"	M. I. Chashkin
"Research and experimental work in forest management"	A. P. Bukshtynov
"Research and experimental work in land and forest improvement"	P. D. Nikitin
"Shelterbelt plantings"	V. I. Matiakin

A. Métro lectured on afforestation for the protection and utilization of arid and semi-arid zone soils in North Africa, and the participants reported on the situation in their respective countries.

The study tour, which lasted from 30 August to 1 October, took the party to Leningrad, Kharkov, Kiev, Kherson, the Crimea, Western Caucasus and several sites in Uzbekistan. Visits were paid to all important forest research establishments, forest schools, arboreta and botanical gardens along this route as well as to numerous forest districts (*leskhozes*), shelterbelt establishments, sand fixation plantations and mountain afforestation works. Except for the tundra, the study tour traversed all the major forest types of European U.S.S.R. and Central Asia: the coniferous forests (*taiga*), the broadleaved belt, the forest steppe, the steppe, the semi-desert and the desert. Mountain forests were inspected in the Crimea, Caucasus and Uzbekistan.

In the establishment of shelterbelts, both the so-called State forest belts which, for instance, follow the courses of the Don and the Donetz rivers for hundreds of kilometers, and the field protective belts on the lands of the collective farms (*kolkhozes*) and State farms (*sovkhozes*), practically all phases of work are mechanized. Research on the effects of shelterbelts confirms in principle the results obtained elsewhere in the world, but the very large scale of the work in connection with the special soil, terrain and climatic conditions give the shelterbelts of the U.S.S.R. a particular note. The increase in the yield of agricultural crops in the steppe region, when grown under adequate shelter, is 10 to 25 percent in favorable years (precipitation above average, fewer storms), 20 to 80 percent in average years, and 50 to 100 percent and more in dry years. (These figures are for spring wheat in the Timashevskoye experimental fields.)

The fixation of sands in the semi-desert areas of Uzbekistan presents features not to be seen elsewhere. A type of forest is being created, based on the indigenous *Haloxylon aphyllum* (black saxaul) which attains a height of 7 to 9 meters in 25 years, with 40 cubic meters per hectare, including branches. Species of *Salsola* and *Calligonum* together with screens are used for fixing the moving sands, and the *Haloxylon* is sown or planted simultaneously or later. During the 30 years of sand fixation work in Uzbekistan, 242,000 hectares have been sown or planted, 222,000 hectares during the last nine years. The work is being increasingly mechanized, and sowing from aircraft and motor vehicles now accounts for 50 percent of the area.

There is considerable public support in the U.S.S.R. for afforestation work, both for protective purposes and to yield timber and other products. This makes it the easier to justify the very considerable investment funds which are required, and in itself carries a lesson for many countries.

A vast amount of technical information was collected during both the seminar and study tour, and that relating to shelterbelt planting, sand fixation, desert afforestation and other protective tree planting was of the greatest interest. Participants were able to make direct comparisons and draw useful conclusions for work in their own countries.

Equipment Section

"GRIBOR" EARTH AUGER. — Equipped with single-cylinder petrol engine with max. power 3.5 hp, 3,200-3,500 r.p.m. Fuel consumption 1 liter per hr. at full speed. Tank holds approx. 3 liters. Chassis of welded steel tubes, has 3 lateral tubes used to fix bars at 3 different heights. Available with augers of various diameters and lengths (easily interchangeable) 5, 9, 12, 16 in. (12, 22, 30, 40 cm.). With 2 men drills 1,200 to 3,000 holes a day.

H. Griot, Maschinenbau, Regensbergstrasse 301, Zürich, Switzerland.

ROOT GRUBBER. — For land clearing and forestry work, mounted on Allis Chalmers HD 14, International TD 14 and Fowler Challenger III tractors. Teeth removable with renewable shoe tips.

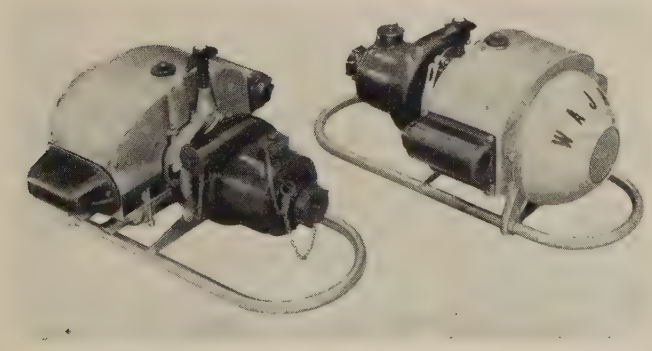
Merton Engineering Co. Ltd., Faggs Road, Feltham, Middlesex, England.

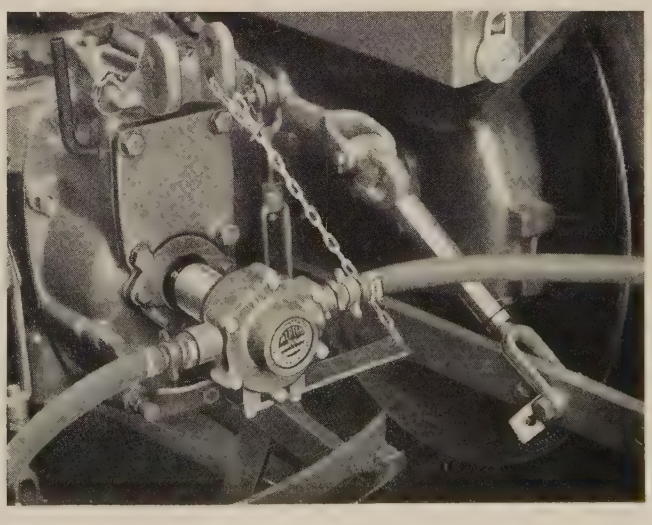
WAJAX CENTRIFUGAL HIGH PRESSURE FIRE PUMP. — *Specifications*: Weight of complete unit 58 lb. (26.3 kg.); overall dimensions: height 13 in. (33 cm.); width 18 $^{3}/_{4}$ in. (47.6 cm.); length 29 in. (73.6 cm.). Free flow capacity 83 imp. g.p.m. (377 liters per m.); shut-off pressure 300 lb. p.s.i. (21 kg. per cm²); engine 2 cylinder, 2 cycle, air-cooled 8. hp motor. Pump detachable from engine without tools.

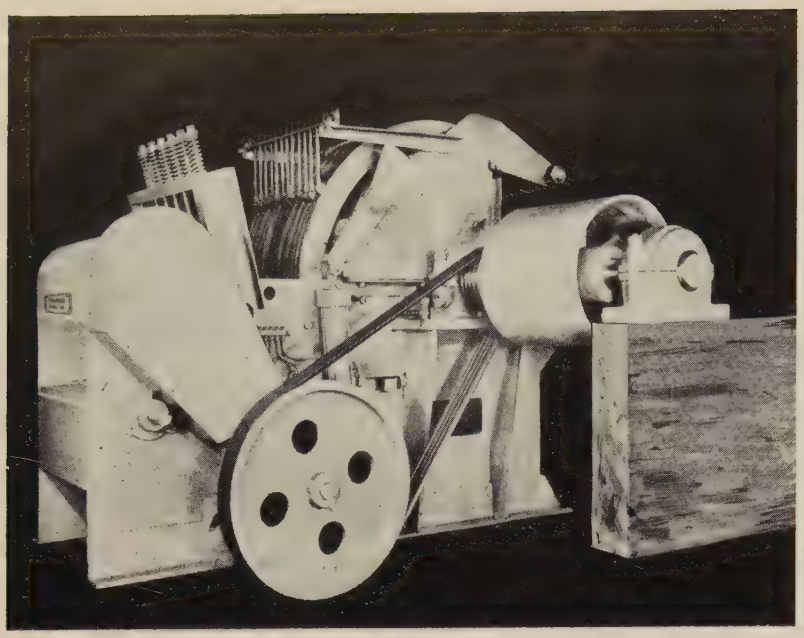
Watson Jack and Company, Limited, 1543 Crescent Street, Montreal 25, P.Q., Canada.

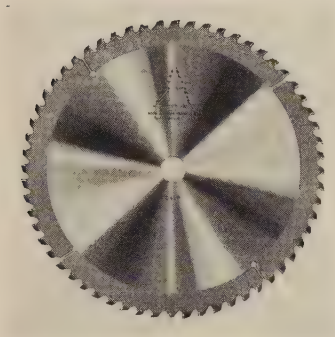
TRACTOR-MOUNTED "ALRECO" PUMP. — For weed and bush-spraying, transport of liquids, car-washing, fire fighting, etc. "Roller-type" pump, operating on vane-pump principle, has 8 rollers in slots in rotor instead of vanes. Built in 3 sizes for direct mounting on tractor's or jeep's power take-off shaft of standard $1^{1}/_{8}$ or $1^{3}/_{8}$ in. (3.49 or 2.85 cm.) size. Chain prevents pump rotating. Pressure ranges from 0 to 25 kg. per cm² (350 lb. per sq. in.).

Allan Rehnström and Co., Gävle, Sweden.









Woodsman Style DA5R Carbisaw Blade. — Carbide-tipped saw blades, double cross rolled, double annealed canter sheets of chrome-vanadium high tensile strength alloy. Double-beveled 45° corner angle of lead tooth working on one diameter followed by the slightly wider raker tooth working on smaller secondary diameter gives multiple chip-cutting action.

North American Products Corporation, P.O.B. 210, Edwardsville, Illinois, U.S.A.

Refuse Chipper. — Feed and opening designed especially for entry of sawmill and veneer waste, not solid round wood. Horizontal feed controlled by individually hung press rolls and synchronized feed table consisting of several feed rolls.

Special feature, practically no oversized chips manufactured

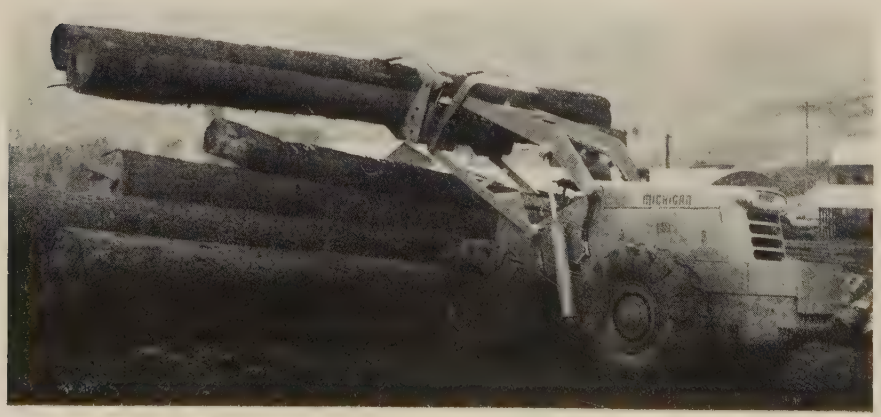
Discharge either through bottom directly onto screen or conveyor or off the rear for conveyance elsewhere.

Specifications: Three sizes, with openings 8 in. × 16 in. (20.3 × 40.6 cm.), 8 in. × 24 in. (20.3 × 61 cm.) and 8 in. × 32 in. (20.3 × 81 cm.). Size 8 in. × 24 in. can handle over 10 cords of chips per hour with constant feed. Drive 75/100 h.p,, depending on stock to be chipped. Directly driven through flexible coupling or by " V " belt or flat belt drive. Feed table synchronized directly to rotor (optional clutch starts and stops feed table without stopping main rotor) or individually driven by separate gearmotor drive.

The Filer and Stowell Co., Milwaukee 7, Wisconsin, U.S.A.

Simon Hydraulic Platform Model IG 40. — Consists of turntable carrying arm jointed to move vertically supporting horizontal platform. *Specifications*: Usually mounted on 4- or 5- ton long wheel base lorry chassis; lifting capacity 750 lb. (350 kg.); platform: reach 40 ft. (12.2 m.); floor area 48 × 34 in. (122 × 86 cm.); max. horizontal extension 24 ft. 6 in. (7.47 m.) from center turntable to front rail; maneuvered by operator from platform. Movements of turntable and booms controlled by hydraulic valves. Weight approx. 2 1/4 tons.

Simon Engineering (Midlands), Ltd., 128-134 Baker Street, London W. 1., England.



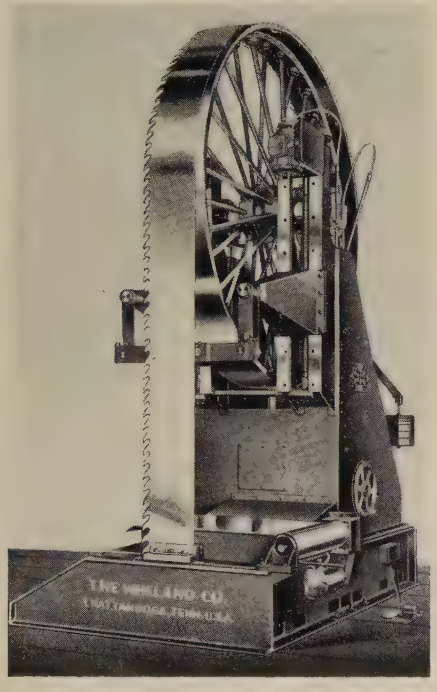
Clark Tractor Logger Model 175. — Engine motor Waukesha gasoline 127 h.p., Diesel 133 h.p. and 165 h.p., 2,200 r.p.m. 4 speeds fwd. and rev. 4 to 27 m.p.h., (6.4 to 43 km. p.h.). 4-wheel hydraulic brakes. Max. lifting capacity 20,000 lb. (9,072 kg.). Fork length 3 ft. (91 cm.); max. log diameter 6 ft. (1.8 m.). Max. height of lift 11 ft. 7 in. (3.5 m.). Turning radius (outside corner fork) 23 ft. 2 in. (7 m.). Ground clearance 19 in. (48 cm.). Accessory: hydraulic winch.

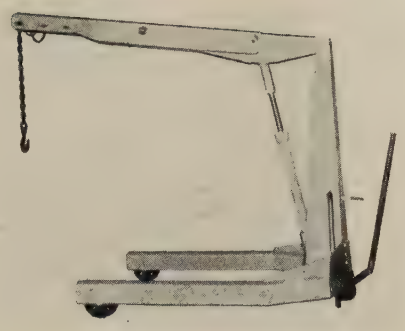
Clark Equipment Company, Construction Machinery Division, Benton Harbor, Michigan, U.S.A.

WHELAND 8 FT. (2.43 m.) BAND MILL. — Built for 12 in. (30.5 cm.) or 14 in. (35.6 cm.) wide saws, includes: motorized doubly-supported top saw guide, motor-driven live lumber roll, patented saw straining device, low centre of gravity; dust-proof construction throughout.

Specifications: Can carry up to 20,000 lb. (9,072 kg.) tension on saws. Max. diameter of log to be split 60 in. (155 cm.); r.p.m. of drive pulley for sawing pine at saw speed of 10,000 ft. (3,048 m.) per minute 400; hardwood at saw speed of 8,500 ft. (2,590 m.) per minute 340. Electric motor recommended 150 h.p., 1,200 r.p.m.

The Wheland Company, Signal Mountain Road, Chattanooga, Tennessee, U.S.A.





STAFFA PORTABLE SHOP CRANE. — Max. capacity 5,000 lb. (2,268 kg.). Load lifted by ram pivoting the jib, powered by hand-operated pump with tank formed in bottom of crane column. Chain and hook attached to outer end of jib are adjustable to provide wider variation in lift. *Specifications*: overall width over legs 5 ft. 6 ½ in. (1.69 m.). Clear space between legs 4 ft. 5 ½ in. (1.26 m.). Overall height jib fully raised 10 ft. 3 in. (3.1 m.).

Chamberlain Industries, Ltd., Staffa Works, Leyton, London E. 10, England.

CHASESIDE LOADMASTER MODEL 500. — Equipped with fork and hydraulic claw fitted on shovel after removal of scoop. Control lever behind driver's seat.

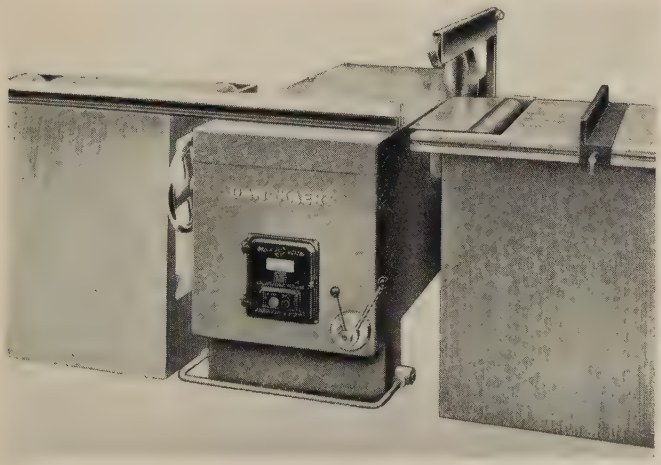
Chaseside Engineering Co., Ltd., Station Works, Hertford, Herts., England.

AUTOMATIC CROSSCUT SAW. — Entirely automatic action, obtained hydraulically. Rate of fwd. travel infinitely variable for 0 to 100 ft. (30.5 m.) per min., instantly adjustable by lever. Automatic return movement 100 ft. per min. Hand wheel allows for immediate adjustment of cutting stroke.

Machines à Bois Danckaert S.A., 55 rue des Vétérinaires, Brussels, Belgium.

RAPIER 12/24 SUPER FORK TRUCK. — Mast arranged to swivel to one side enabling load to be carried end-on, in line with direction of travel. Can enter transverse lane between sets, pick up load at the end, back out into main gangway and maneuver into traveling position with load alongside. Road speed up to 20 m.p.h. (32 km.p.h.), max. lifting and carrying capacity 12,000 lb. (5,436 kg.).

Ransomes and Rapier, Ltd., Waterside Works, Ipswich, England.



FAO accepts no responsibility for the claims of manufacturers

News of the World

Bolivia

• Bolivia has an area of 110 million hectares and lies between the 10th and 23rd south parallels; it is therefore entirely within the tropical zone. Nevertheless, the Andean mountain range that covers one-third of the territory greatly modifies the climate and also the vegetation of the forests which occupy 41 percent of the area of the country.

According to an FAO officer who has recently completed a technical assistance assignment in the country, Bolivia can be divided from the forestry standpoint into two completely distinct regions which can themselves be subdivided.

1. *Andean mountain range*

a) *Altiplano.* This is a bare but fairly populated high plateau spread out at altitudes of from 3,500 to 4,500 meters. The climate is harsh, with an annual mean temperature from 7 to 9 degrees with many frosty days. Rainfall is unevenly distributed and from 700 to 800 millimeters fall during 6 months. Day and night temperatures vary considerably. The air is very bright and dry. The very open climax forest has almost completely disappeared as a result of overfelling and overgrazing. It consists mainly of yareta (*Laretia compacta*), keñua (*Polylepis* sp.), and kishuara (*Buddleia* sp.) that provide excellent firewood.

b) *Inter-Andean zone.* This lies between 2,000 and 3,500 meters. It consists of valleys running in various directions separated by plateaus and mountain chains of varying heights. The climate is semi-arid, the mean temperature is from 16 to 18 degrees; frosts are infrequent and slight; the rainfall is from 500 to 700 millimeters; the winter is absolutely dry. The further south one goes, the drier the climate becomes and the more numerous the days of frost. The vegetation is characteristic, homogeneous and often thorny. It includes, for example, *Schinus molle*, *Carica lanceolata*, *Acacia cavenia* and *A. visco*, *Prosopis alba P. nigra* and *P. ferox*. etc. A willow (*Salix humboldtiana*), the wood of which is often used, grows alongside the streams. Probably cedro (*Cedrela* sp.) and walnut (*Juglans* sp). which have now disappeared, also grew formerly in the more humid parts of this zone.

c) *The humid eastern slopes of the Andes.* In the east the Andes form a mountain barrier that moisture-laden clouds cannot easily cross. The result is a heavy condensation that leads to downpours of over 2 meters. The atmosphere is very humid with frequent fogs. The vegetation changes rapidly from the preceding type to that of a humid climate; at an altitude of from 2 to 3,000 meters it consists of a number of limited species in which pino (*Podocarpus* sp.) predominates; as one descends, the mountain forest gradually merges into rain forest. The cedrela appears first and is followed by walnut, alder (*Alnus jurullensis*), laurel (*Ocotea* sp.), nectandra (*Ocotea* sp.), etc. Several logging enterprises concentrate on cutting mainly *Podocarpus* and *Cedrela*.

2. *Eastern plain*

a) *Amazonian hylea.* The climate is essentially tropical with uniformly distributed rainfall. This region is covered with forests where very little exploitation is done owing to lack of access routes. The trees include mahogany (*Swietenia* sp.) and cedrela, as well as the brazil nut (*Bertholletia excelsa*) and rubber tree (*Hevea* sp.). But the soil is poor and the forest contains relatively few valuable species.

b) *The pampas of the Trinidad region* are of no interest from the forestry standpoint.

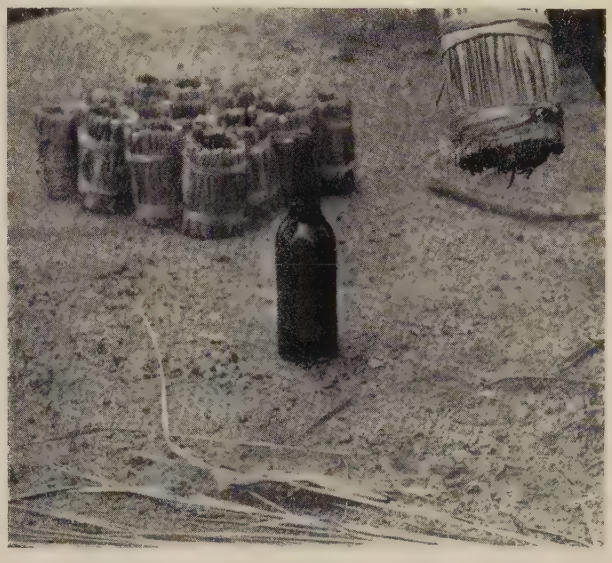
c) *The Santa Cruz region* has intermediary type forests between the rain and the deciduous forests. At Santa Cruz itself the mean temperature is 23 degrees with a rainfall of 1.30 meters. But at the foot of the Andes, it may reach 2.50 meters. It is in the latter zone where the soil is often fertile that the richest forests of Bolivia are found. They contain merchantable species such as mahogany, cedrela, Amarillo (*Aspidosperma* spp.), cuchi (*Astronium* sp.), curupau (*Piptadenia* sp.), trompillo (*Guarea* sp.), tarara (*Platymiscium* sp.), ochoo (*Hura crepitans*), gabum (*Virola* sp.), sauco (*Zanthoxylum* sp.). The mahogany trees are sometimes so far apart there are only three per hectare, with a workable timber volume of 17 cubic meters. From this region comes most of the timber logged in Bolivia.

d) *The Chaco* carries a not very homogeneous deciduous forest where one finds either fairly dense stands with trees from 15 to 20 meters tall, low thorny vegetation, or palmgroves. The rainfall is approximately 1 meter. The climate is very hot in summer and relatively cold in winter. The last great world reserve of *quebracho*, which has never been exploited in Bolivia except for making railway sleepers (crossties), is located in these parts. Other species are roble (*Amburana* sp.), mesquite, etc. There is a plan to establish a tannin plant here.

Brazil: *Inventorying the forest resource has formed a basic task of the FAO forestry mission in the Amazon Valley. From an interpretation of aerial photographs, several areas were selected that appeared promising for timber extraction and where ground surveys should be carried out. These surveys and the resultant maps have now been completed for an area of 2 million hectares to the south of the Amazon river, between the Tapajos and Xinger rivers. The photograph shows an inventory crew encampment during the field work, which is now being extended to two other areas.*

The original forestry mission has grown into an FAO-wide mission and UNESCO experts are also participating.

Photograph: R. Lemos Froes



CAMEROONS: *A correspondent has sent the above series of photographs to illustrate a very simple method of making containers for the transfer of tree seedlings.*

Photograph: J. Guillard

Cambodia

• A letter from the Chief of the Forest Service says that, since the signing of the Geneva pacts, the re-establishment of internal security, particularly in the forest regions, has made it possible to resume forest management work.

The forested area is currently estimated at approximately 10 million hectares, including 300,000 hectares of dense forest, 500,000 hectares of open forest, 90,000 hectares of flooded forest and 100,000 hectares of poor savanna and scrub: 390,000 hectares of forests have so far been classified, distributed fairly uniformly throughout the country. All forests are State property.

While field work was almost impossible for several years owing to the state of insecurity, there has now been considerable resumption of activity, which is bound to increase during the coming years. A first task was to assess the damage done, both as regards the forests themselves and all the forest works (roads, tracks, bridges, forest rest-houses). There had been a recrudescence of forest clearing, especially in dense forests.

The resettlement of villagers from the disturbed areas has also encouraged to some extent the opening of new cultivation areas, at the expense of the forest. Unfortunately such expansion of cultivation has not always taken place on land suited for crop growing.

For security reasons, stands bordering many roads were also cut back as far as 50 meters on either side. Finally, owing to the lack of fire control work, several million hectares of open forest have been ravaged by running fires during the dry season (particularly in January and February). Such fires have burned openings in the stands, many of them thinly stocked, which are thus left sparsely wooded and afford little protection for the soil. The greatest damage occurs within the perimeters where the open forest is clear cut. Almost all fires are caused by man, mainly when hunting. In fact, the burning over of vast areas of wooded savanna during the dry season leads to a rapid growth of many grasses of which wildlife is very fond. In inland forest areas, where farming is primitive and the diet of the inhabitants of the forest villages very ill-balanced, especially in regard to protein foods for a large part of the year, game meat is a valuable diet supplement.

It cannot be expected that a situation that has rapidly deteriorated over the past 4 or 5 years and virtually wiped out the achievements of 50 years of forestry work, can be corrected for many years.

The first efforts in 1955 were mainly concerned with the repair of a big network of forest roads and tracks (2,900 kilometers) to make possible the effective inspection of the forests. Plantations after cleaning and improvement plantings with valuable species (various *Dipterocarpus*, *Hopea odorata*, *Tectona grandis*), have been maintained as in the past. Many nurseries have been established throughout the country, and finally, the Forest Service has made successful attempts to reforest areas cleared during the period of unrest. These plantations are associated for two or three years with food crops (soya and maize for example), which considerably reduces the cost of planting work and of subsequent weeding and maintenance.

The resumption of full-scale logging and extraction makes it possible to ensure the regular supply of timber and forest products to the domestic market. Moreover, there are considerable stocks of logs at felling sites ready for delivery. The usual export markets (especially the Saigon-Cholon market) have however been more or less closed by the new economic and political structures of Cambodia and Viet-Nam. The cessation of hostilities also led to the disappearance of an important market in the form of armed forces procurement. Consequently, new markets within the limits of a restored export industry will have to be sought for the future.

Cambodia has great timber resources that would enable the volume of exports to be considerably increased without encroaching on the future growth of its forests. Large squared

logs (various *Dipterocarpus, Hopea odorata, Shorea, Anisoptera, Lagerstroemia, Sindora, Tarrietia*), railway sleepers (crossties), poles for electric cables, timber for undercarriages, etc., could be exported, and also a considerable quantity of *Pinus merkusi*. For the time being, expansion of the timber industry is hampered by the very high domestic prices for timber of all sizes. A great effort will have to be made in the coming years considerably to lower prices obtaining on the timber market both for domestic consumption and for export. The port of Phnom-Penh, which, under certain conditions, is accessible to seagoing ships, can be used for export shipments. Moreover, the port of Kompong Som on the Gulf of Thailand may be expected to come into service toward the end of 1957 and make possible the full utilization of rich, still unexploited forests within a radius of 100 kilometers around this port.

An emergency plan for the re-equipment of Cambodia covers the years 1956 and 1957, and is to be followed by a definitive plan that will probably cover a four-year period. The two-year plan is financed out of national funds with some foreign aid and technical assistance from the United Nations.

Canada

• It is reported that increased use of prefabricated buildings on the cutting site has led one of the biggest woodworking firms in the Maritime Provinces to set up a special division working on prefabricated units for logging and construction firms.

Time-saving in erection, and cost-saving through re-use over several operations, the most popular unit is a two-storey building 28 feet wide by 128 feet long (8.5 × 39 m.) with a capacity for 190 men. Insulated and finished with plywood inside and out, this building can be erected in 60 man days and dismantled in 18, and can be shipped in three box cars. Living quarters are four-men cubicles, the galley and staff quarters are on the ground floor.

Keeping abreast of the trend towards family units in semi-permanent camps, a special house with three rooms is now being made available to industry. Its cost will be slightly over $3,000 and it consists of three rooms — a kitchen and two bedrooms. All plumbing fixtures are supplied along with a wiring kit which is installed on the job. Few if any of the buildings will be erected on a permanent foundation so plumbing would have to be brought up from the ground in an insulated box.

Standard wall panels are four by eight feet (1.2 × 2.4 m.) with floor panels up to 12 feet (3.7 m.). All are insulated with rock wool two and a half inches (6.4 cm.) thick. The material used is Douglas fir plywood and spruce.

• Dr. D. A. Macdonald, Director of the Forestry Branch, Department of Northern Affairs and National Resources since 1948, retired at the end of last year, after 42 years of service to forestry in Canada.

He is known internationally for his activities in support of forest conservation. In Canada, he was closely associated in the preparation and eventual administration of the Canada Forestry Act of 1949. Through the Canada Forestry Act, federal financial aid has been provided for inventories of the provincial forest areas and for reforestation. These forest inventories will provide governments and industry with the information on which scientific forest management plans can be based. Through the aid to reforestation, nearly 58 million trees have been planted on unoccupied Crown lands.

Dr. Macdonald served energetically on many national and international forestry organizations. For many years he was a director of the Pulp and Papers Research Institute of Canada and the Canadian Forestry Association. He also served as chairman of the Forest Insect Control Board of Canada. He was head of the FAO preparatory conference on World Pulp Problems at Montreal in 1949 and was a member of the original advisory committee of FAO's Forestry Division. He was Canadian delegate to the Third World Forestry Congress at Helsinki, Finland, and the Fourth Congress in India, and chairman of the Sixth British Commonwealth Forestry Conference held in Canada in 1952.

Chile

• A new enterprise called the *Empresa Nacional de Celulose* is being organized with the financial backing of several government organizations. The initial capital subscribed amounts to the equivalent of U.S. $10 million with an additional sum of U.S. $9.6 million in foreign credits to cover the purchase of machinery and furnishing of professional services. The raw material will be derived from insignis pine (*Pinus radiata*) plantations of the Huepil region. The project is based on previous studies made by FAO, the Economic Commission for Latin America (ECLA) and the *Corporacion de Fomento* of Chile.

Colombia

• Under the auspices of the Andean Zone, of the Inter-American Institute of Agricultural Sciences, the *Facultad National de Agronomia* and the Forestry Institute of Medellin, an intensive course on tropical forestry was held at Medellin, in July and August 1956. The course covered forestry practices and included study tours in the high zones of Antiquoía and the tropical lowlands of Urubá.

Twelve students of the fifth year of the Forestry School of the *Universidad Distrital Francisco José de Caldas* in Bogotá, made a study tour of 19 days to Venezuela. They attended a special 10-day training course at the Forest Faculty of the *Universidad de los Andes*, Mérida, and spent the remaining days visiting forests, forest industries, national parks and agricultural colonies.

Czechoslovakia

• A paper prepared for the FAO study tour mentioned earlier in this issue described the historical-economic situation which lead to the extensive establishment of pure, even-aged stands of spruce and of pine. This situation was caused, first, by the continuously increasing wood consumption of numerous rapidly-developing industries.

Considerable increase of the brewing and distilling industry; of glass, potassium, stone, lime and brick production; and rapid growth of the foundry and of the iron industry, all caused a continuous expansion of wood requirements.

The condition of the forest stands after a period of several hundred years made it impossible to meet such increased demands.

In the course of several centuries, almost the entire volume of wood was cut out of these stands. First of all, the stands in the most heavily inhabited regions and especially in the vicinity of towns and industrial centers suffered from the fact. Later on, however, even the forests in remote regions and in mountains were subject to such intensive utilization. As an example, there were the silver mines in Kutná Hora, for which the necessary wood, especially of greater diameter, was transported from sources as far as the mountains of Krkonose in northern Bohemia. Also many industries were founded directly in the foothill regions and in the mountain regions as the Sumava mountains where at that time sufficient growing stock rendered great possibilities for the development of production.

The felled stands were left entirely without further care. Artificial regen-

eration was an extremely rare event at that time. Natural regeneration failed, because of heavy damage to the advance growth by pasturing of stock and because of the large number of game especially in farm forests. Besides, changes took place in the composition of the forest resulting in a higher percentage of more vigorous but less commercially valuable, or even valueless, species such as birch, aspen, and juniper.

In the second half of the 17th century and in the early 18th century, care and regeneration of the forests were still left to their owners. At that time, however, those private clerks entrusted with the management of the forests had no thorough training in forestry. Despite this fact, even in this period, there began to appear thorough studies, in which chapters were included even concerning silviculture, afforestation techniques and instructions relating to the establishment of forest nurseries.

In the meanwhile, the State in no way interfered. Faced with the lack of wood, the State did not adopt any other measure except issuing permits or prohibiting the export of timber, and securing wood material for the enterprise in which it was interested. A significant turning-point in this situation was the forest regulation in 1754, which ordered forest owners to follow the principles of correct management in the forests, especially those owned by the towns. This management was to be inspected by district authorities. Besides this, there were in this regulation also provisions, relating to economical use of wood, and special, detailed instructions contained silvicultural directions.

Wood scarcity and forest devastation caused greater attention to be paid to the regeneration of forest stands. From this time onwards various essay competitions were held, to encourage the best suggestions for forest improvement. The number of forestry publications in the form of instructions and textbooks also increased, while the first systematical forest management was initiated.

Greater care for forest stands to meet the scarcity of wood was to a certain degree dependent on fast and cheap afforestation of the hitherto unproductive forest areas. Not all tree species were, however, suitable for this purpose. It was a well-known fact that raising broadleaved tree seedlings required much greater care than the cultivation of coniferous trees. Besides, the seeds of softwood, especially of spruce and pine, could be secured relatively easily. The seed fertility of both these species was uniform and high. Extracting, storing, and sowing such seeds was not difficult. The seedlings of both these species were also very hardy against the extreme climatic conditions of large cut over areas and of open stands. In the first years following planting, spruce and pine suffered much less from game damage than did the broadleaved species. All these circumstances resulted in afforestation of devastated forest stands, with more and more spruce and pine rather than with the original species as, for example, oak, hornbeam, lime maple, beech and others.

The new pure even-aged stands of pine and spruce with their rapid early growth and with their simple stand formation, on which also simple tending of stands is based, very soon became the ideal of forest management. And consequently, though the foresters at first tried in the regeneration of stands to proceed along the lines of nature by trying to form mixed stands with native species, nevertheless, from the sixties of the 18th century, they began to find that it was much more advantageous to plant unmixed and even-aged stands, using such coniferous species as spruce and pine. In keeping with these new tendencies, an entirely new way of liquidation of the old stands was taken. The previous system of selective cutting was completely rejected and replaced by a very radical system of clear cutting. In this way, of course, the requirement of fast afforestation by pine and spruce seed material was still more necessary. Further increase of this silvicultural system was based upon alternate forest and agriculture methods on the clear cuttings, which substantially changed the entire biocenosis of previous stands, because in this way even undergrowth was affected and the structure of the soil was changed.

Undoubtedly the new methods of silviculture, based on complete liquidation of the stand over great areas, and at the same time on the artificial regeneration of such areas, introduced a definite system into existing silviculture. This was, in fact, the first large-scale attempt at planning in forest management, for which even a special theory was elaborated concerning the highest land rent, the financial rotation, the economical tree species and so on. It is also indisputable that the pure stand form brought at that time temporary financial advantages to the forest owners of that period, higher production of forest stands was achieved and, in particular, an assortment of the most valued softwood was produced, as a result of the development of the chemical wood working industry. To achieve this purpose, suitable, simple, cheap systematic methods of silviculture and management were available.

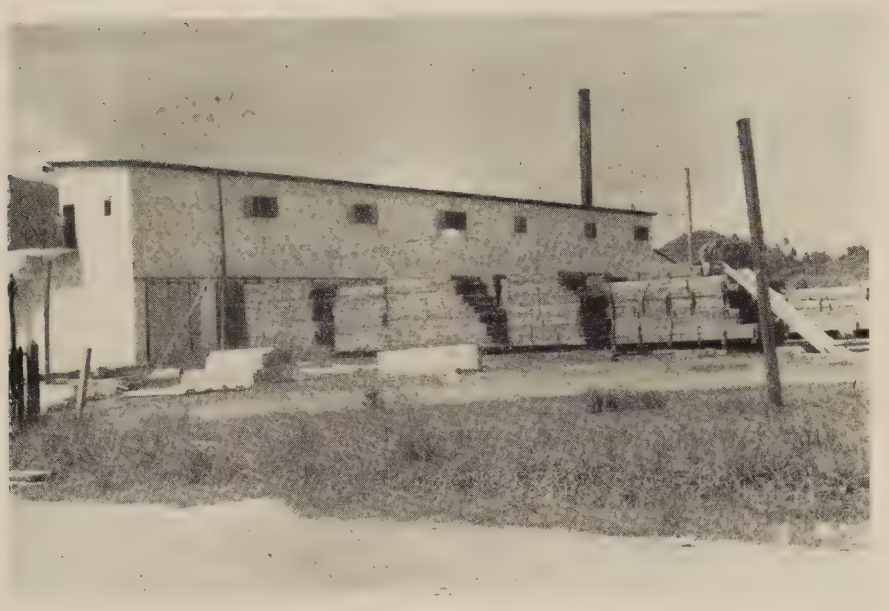
But even in the first period of establishing pure stands Cotta (1816), Laurop (1822), Klein (1826), Cerny (1836), Pfeil (1837-60), Hejrovsky (1837) and many others called attention to the fact that the mixed forest, as seen in the original natural forests, was necessarily to be considered as the most perfect type of forest; as that in which all components were organically connected into one perfect unit. In this case, the entire air and ground space was most perfectly used. The tree species, often of different qualities, complemented one another without harm. Also from the standpoint of resistance to natural damage and game damage the mixed forest was more advantageous than the pure stand. Another advantage was the greater possibility of good game management, and so on.

All these mentioned advantages or disadvantages of mixed forest or of pure stands were, in the course of the latest few decades, discussed many times. Many systems of regeneration tending and utilization were worked out.

If, nowadays, there is a revision of opinion on the clear cutting and pure stand system, then this is caused both by some unfavorable results of pure stands and by other economic necessities.

Dominican Republic

• The FAO Regional Forestry Officer reports that, in the Dominican Republic, there exists a law prescribing that all lumber has to be dried artificially. As a result, the Government has built seven large dry kilns and situated them at strategic points. In La Constanza, for instance, sixteen sawmills send their green lumber to the kiln. Beside the kiln each sawmill has its own small planemill where most of the lumber is planed. Then the dried and planed lumber goes by truck to the consuming center, thus saving considerably on transport costs (probably an average of 20 to 30 percent) and several weeks or months of time for open drying. It also avoids blue stain. The kiln has a capacity of 200,000 board feet of lumber in a shift (six stoves with two chambers each) and in 1955 dealt with 8,500,000 board feet. The price for drying is 15 pesos (1 peso - U.S. $1.00) for small quantities and 12 pesos per 1,000 board feet for large quantities. This corresponds to about 10 percent of the selling price in Ciudad Trujillo. The kilns built by the Government are turned over to private enterprises, but the Government has fixed the prices for drying. All parties concerned seem to be satisfied with this solution.



DOMINICAN REPUBLIC: *Dry kiln in La Constanza: 16 sawmills send their lumber for drying to this kiln.*

ETHIOPIA: *The first Arbor Day in Ethiopia, organized by Mr. Vernède and Mr. Bosshard, two FAO technical assistance officers, and held at the 28 acre (11.3 ha.) Forest Experimental Nursery at Holletta on 16 July 1956, is reported to have been a great success. The Emperor and members of the Royal Family, the Minister of Agriculture and other Ministers and high-ranking personalities, civil and military, attended. The Emperor and the Minister of Agriculture addressed the gathering and planted trees.*

Germany

• The bark-beetle (*Dendroctonus micans* King.) which has been relatively rare in the past, has become an increasingly dangerous parasite to Norway spruce and Sitka spruce in Schleswig-Holstein during the last 10 years, mainly in reforestation areas. The premature felling of trees attacked by this pest resulted in uneven stands which thus were particularly exposed to wind. The commonly used control methods against bark beetles did not give the desired results.

In the autumn and winter of 1953, the bark-beetle was fought in two different districts of the Forest Service in Flensburg under the direction of the *Bundesforschungsanstalt für Forst- und Holzwirtschaft* (Silviculture and Forest Management Organization) in Reinbek, by means of a previously approved "Mobe" T (HCH–preparation manufactured by Merck) and by means of a new method, namely the applying of poison to the trunk. The ravaged but still living trees were not cut, but saved for the stand.

After the first application of poison in the first of the two districts, 48 percent of the attacked Sitka spruce and 56 percent of the Norway spruce were saved, and in the other district, 48.5 percent of the Sitka and 62.5 percent of the Norway spruce. After the second application of poison in 1954/55, only 45 cubic meters had to be felled in the first of the two districts, while in preceding years up to 350 cubic meters had to be cut down prematurely. The communities of beetles had been reduced, and fresh outbreaks were rare. Consequently, silvicultural practices aimed at certain changes in the stand composition could be carried out according to plan, whereas previously, planned silviculture had often not been possible due to the unusual amount of trees that had to be felled. Application costs were reasonable.

Hong Kong

• Investigations and small-scale experiments have been continuing in silviculture, seed of new species has been obtained from abroad and trial plots planted in various localities.

It has been found that the use of bare-root pine transplants is only a success if the weather is favorable and the transplants are the optimum size at the time of planting. As the planting season is so uncertain, it is difficult to arrange to have transplants of the right size at the right time and, in order to ensure that plantations are established in one to two years, it may be necessary to retain a larger proportion of the pine in tubes for replanting. Survival of transplants is very variable, the average being 30 to 60 percent: with tubes 90 to 100 percent survival is obtained. As tubed plants are much more expensive to produce and to plant than transplants, the most economic method would seem to be the use of both transplants and tubed plants, the former during the most favorable weather and the latter during unfavorable weather and for replanting. Pine has given the best results in grass areas and it has been found that weeding is unnecessary as the young plants come up through the grass quite well.

With the eucalypt species, growth has been rather disappointing in most areas and it appears that *Eucalyptus robusta* (syn. E. *multiflora*) is not suited to most of the sites on which it has been planted. It is therefore being kept for the moist, sheltered sites which it favors.

The most promising of the new species being tried for afforestation is Casuarina (*Casuarina equisetifolia*) and it has been found that it shows a remarkable response to superphosphate even in very small quantities. It is hoped that this species will be satisfactory on the sites which are not suitable for eucalyptus.

Casuarina cunninghamiana is also being tried.

Other species which are giving good results in trial plants are *Cryptomeria japonica* (on sites over 1,000 feet [300 m.]) a species of Japanese alder, *Callitris* sp. and *Tristania conferta*, all of which will be tried on a larger scale in the future.

Iran

• An FAO officer of the technical assistance mission in Iran writes:

" On the Shiraz-Isfahan road we stopped for a short while at Tachkteh Djamschid (75 kilometers from Shiraz) to visit the ruins of Darius' palace at Persepolis. The archeological interest of this visit was far exceeded by the importance of a forest botany observation.

Persepolis is situated on a kind of terrace partly natural and partly hewn artificially out of the natural rock at 15 to 20 meters above a vast and fertile plain. It still impresses one with the same feeling of power and wealth which must have struck the foreign ambassadors who were received by Darius in this sumptuous stone palace with a forest of huge columns climbing towards the blue sky, strangely contrasting with the town below of small houses built of clay bricks.

All the walls of Persepolis are covered with bas-reliefs representing either King Darius, soldiers or scenes of triumph: these scenes unfurl like a film over a length of more than two kilometers. The height of the figures (except those of the king which are more than life-size) is generally 60 centimeters. The most interesting series for us, from a botanical and forestry point of view, were those of Darius' triumphal processions. Here are represented all the peoples who formed his immense empire. Each nation is generally represented by a group of three men dressed in their traditional costumes, carrying gifts and led by one of Darius' officers. The groups are separated, one from the other, by a tree, which is always the same tree. This tree, with its regular, pyramid form and its erect growth, has been interpreted as a cypress. However, it was drawn and sculptured so precisely and in such detail, that one is sure that the artist wished to represent young specimens of *Pinus heldarica;* the trunk is covered with the characteristic scaly bark, the branches are covered with leaves and the ends are bent up in the air like candles, the well-developed terminal buds are visible and erect, and their needles look like rounded tufts. The final point which leaves no doubt is the cones, which are sessile, spread out, sometimes vertically, growing near the ends of the uppermost branches, and which always lean towards the tops of the branches. We took some photographs of them; in the reproduction the design is even clearer than in the original.

This discovery is very interesting because it proves that *Pinus heldarica* was already well known in Persia in Darius' time (approximately 500 B.C.) and that its introduction is not recent. I can merely state this fact, but am not able to assert that *Pinus heldarica* grew naturally or that it was introduced by Darius after his victorious wars.

The area where *Pinus brutia* Ten. (of which *P. heldarica*, still requiring much study from a botanical point of view, is a variety or rather a geographical species) grows naturally is Greece and the Near East: Cyprus, southern Turkey, Syria and the Lebanon. Here, it often shows a transition towards *Pinus halepensis* Mill. of which it was once believed to be a variety, due to the fact that botanists always worked on dried or preserved specimens and were never able to examine the living species in the different parts of its natural habitat.

The most eastern region where *Pinus brutia* is known to grow naturally is Zawita on the western slopes of the principal range of the Zagros mountains in the north of Iraq (half way along the road between Mosul and Amadiya, and more precisely between Dohuk and Sirsing). It is believed that there is a more eastern area of natural growth in Afghanistan, but this has not been verified.

That *Pinus brutia* was well known and appreciated in ancient times is also proved by another bas-relief which attracted our attention. It came from Niniveh (Mosul, Iraq) and is now in the Archeological Museum in Baghdad, Iraq. This bas-relief portrays a triumphal scene and in the background are shown fully grown pines. Although these are stylized (contrary to those at Persepolis which are reproduced with almost photographic precision) one can easily recognize *Pinus brutia* of the Zawita geographic type by the scaly trunk, the whorled branches, spread out and with the extremities bent upwards like candles, the branchlets covered almost to the base with rounded needles which form a sort of " horn of plenty ". The foliage appears thicker (the needles of *Pinus brutia* from Zawita are rather dark in color and last for several years so that the branchlets and even the branches are covered) than that of the pines illustrated at Persepolis. (In actual fact the crowns of older pines are always more dense with needles than the crowns of young trees.)

These bas-reliefs prove that *Pinus brutia* was well known in Iraq in the time of Niniveh (approximately 800 B.C.) and that another pine very similar to *Pinus heldarica* was known in Iran in the time of Darius (approximately 500 B.C.). However, the fact that at Persepolis *Pinus heldarica* is always shown in the form of young trees and always used as a separation symbol between triumphal processions could mean that it was introduced and cultivated by Darius, and that he had seen and admired it during his campaigns. (This theory might explain the strange lack of natural *Pinus*, *Picea* and *Abies* species in Iran.)

From these observations we could conclude that *Pinus heldarica* was already known in Iran during the time of Darius, but we are not able to state dogmatically that the *Pinus heldarica* now cultivated in Iran is the descendant of the trees portrayed at Persepolis. If one considers the form and habit of the pines cultivated today (with their rounded and less regular crowns, their branches spread out more horizontally and their extremities less bent upwards), they seem more closely related to those which grow along the Syrian coast near the Latakia forest, rather than to the Zawita pines.

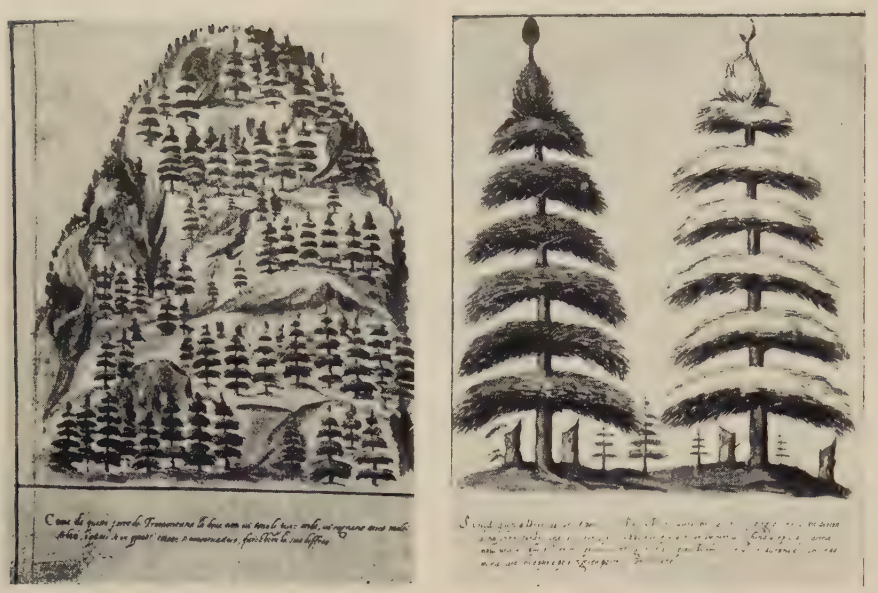
The largest and oldest examples of *Pinus heldarica* which we saw during our tour in the parts of Iran we visited, are in the garden of the American Church of Julfa (Isfahan). They reach a height of about 20 meters and have a rounded and flattened crown like an umbrella: they are said to be 180 years old. "

Italy

• Late in 1601, Iseppo and Gieronimo Paulini, forest owners living in the province of Belluno, submitted a memorandum to His Most Serene Highness the Doge of the Republic of Venice suggesting measures to prevent silting of the lagoon. Twenty illustrations and tables were attached to the memorandum, which constitutes one of the first, though elementary, manuals of silviculture, land use and management of catchment areas.

The authors first drew the attention of the Doge to the inanity of the very expensive engineering works carried out in the past in the plains for the purpose of erosion and flood control, if the problem were not tackled at its very origin in the catchment areas. They pointed out convincingly that the silting of the lagoon had commenced about a hundred years earlier, following the farmers' deforestation of the mountains mainly by means of fire in order to enlarge their croplands and grazing grounds. Erosion then set in, and as a result large quantities of rock particles and mud were conveyed to the sea by the rivers, eventually silting up the lagoon.

Two different measures were advocated: strict prohibition of fires in the forests, to be enforced with close control by special guards and the infliction of heavy penalties to violators; and the construction of a tight net-



ITALY: *The four pictures represent.*

1. *How a mountain forest should be managed to reduce run-off and afford protection against soil erosion.*
2. *The action of trees to lessen the impact of the rain or snow on the soil.*
3. *The clearing of the Serpentina Valley, the resulting erosion and consequent increase in bed-load material.*
4. *The development of two tributaries of the Piave river at the dawn of the seventeenth century, which only 60 years before were mere brooklets.*

work of contour ditches on the slopes and between watercourses in the plains to lessen the impetus of the surface run-off and allow the silt to settle; being fertile, it should not be wasted by letting rivers convey it to the sea. It is interesting to note in this connexion the treatment suggested for the natural vegetation growing in the river beds and consisting mainly of willows, which should be cut every five years and not any later, as bigger-size shoots would not be flexible enough to slow down the running water without being uprooted.

Laos

• The majority of the peoples who inhabit the mountain regions of Laos practise shifting cultivation. This practice is particularly widespread in the north of the country, and the deforestation caused by forest clearing constitutes one of the principal problems of the Forest Service.

This body, since its creation, has tried to abolish the practice. First, a school, intended to encourage permanent cultivation methods among the population, was created on the plateau of Xieng Khouang. Then a policy of confining the areas where shifting cultivation was practised was introduced.

However, Laos has a fairly small population, and it is therefore still possible to find fertile land not being cultivated. For this reason the Forest Service from 1950 onwards made attempts at resettling the hill tribes and establishing them on land suited to rice growing.

The first attempts were modest and consisted in supplying the families evicted from the forest reserves with tools, draft animals and seeds. Little by little the technique of rehabilitation was improved, and it was soon apparent that the results obtained

were much better than anything tried previously.

The essential part of the work is now the creation of rice fields, which are then managed by the people themselvss. In 1955-56, in the region of Xieng Khouang, three resettlement centers were established: 113 families installed themselves voluntarily; one of the centers intended for 26 families finally received 56: 130 hectares of rice fields were laid out and 20 kilometers of irrigation and drainage canals dug. These works were financed by funds of the National Budget and American economic aid.

The first results may seem negligible in comparison with the magnitude of the problem of shifting cultivation in Laos. But perhaps, more than the material results, it is their demonstration value which is important. Indeed, the reception of this project by the local people has been excellent. The resettled populations are made up of half of each of the two races which traditionally practise shifting cultivation: the Laotians and the Meos.

A few years ago any attempt to change the life of these people was considered impossible, but this experiment has shown that this is not the case and that often they ask for nothing better than the chance to settle permanently.

Liberia

• Since 1951, experts of the United States International Co-operation Administration (ICA) have worked in the Republic of Liberia to aid in studying the forests and their possibilities, in setting up a system of forest conservation and administration, and in creating a program for selecting and training foresters. This program follows and expands an earlier program begun in 1947 by an expert of the U.S. Economic Mission to the country.

Although shifting cultivation is the prevailing method of the country and has been used for a long time, there still remains a large area of high forest. The major divisions of land condition are as follows:

Condition class	Total (acres)	Percent. of total land area
High forest (old growth)	8,950,000	37.6
Broken forest	4,850,000	20.4
Low bush (second growth)	5,250,000	22.1
Non-forest	4,750,000	19.9
TOTAL	23,800,000	100.0

Thus the country is fortunate in that a substantial estate remains available for future use under rational planning.

An ICA report mentions the main results of recent work as being:

1. Increasing realization that conservation measures are necessary to prevent destruction of a valuable resource. This has been reflected in support of forestry measures from the agencies of the government.
2. The budget for forestry, while not large, is increasing rapidly.
3. A Bureau of Forest Conservation has been established to deal with the national forests which are in the process of survey and establishment. The problems of boundary establishment are great, but one unit is already set up and surveys of others are under way with a goal of several million acres in sight.
4. A professional forestry curriculum has been established in the University of Liberia, with two professors provided by FAO. The first class will graduate in 1958, and it is expected that, after that time, the forestry faculty will be manned by Liberians.
5. A national forest timber sale contract has been entered into with an established private operator. Although moderate in size, it is expected that further contracts will be made in the national forest areas now being set up.

Netherlands

• The first census of woodlands was made in 1938-1942. However, when the collecting of data had been completed, a considerable area of forests was felled because of the war. Although a supplementary survey of felled areas was carried out in 1945-1948, the results were not up to modern statistical demands. Up-to-date figures were necessary to get information about timber supply and growth, and for forest economics, forest policy and agricultural and recreational planning. Moreover, the existing figures did not meet the requirements of the international forestry statistics of FAO.

The first census comprising woodlands, roadside plantations and waste lands only gave figures about area and ownership. It showed a total woodland area of about 250,000 hectares (620,000 acres), a total waste land area of 226,000 hectares (570,000 acres) and 47,850 kilometers (30,000 miles) roadside and single-row plantations.

In 1942 the ownership was as follows:

Type	State	Municipal	Private	Other
	..... percent			
Woodlands	15	15	65	5
Road plantations	8	22	60	10
Waste lands	21	13	56	10

In 1952, a new forest inventory was started, to gain detailed information about the composition of the woodland and waste land area in each of the eight forest regions in which the country has now been divided. The inventory of the first region, comprising the eastern part of the province of Utrecht and an adjoining small part of the province of North Holland, was carried out in the years 1952-1953; the inventory of the second region, in this case the western part of the province of Guelderland (named Veluwe) has recently been finished. About 1962, the census of the whole country should be completed.

This census of woodlands involves the following data:

a) classification of the woodland area by forest types and species;
b) number and area of the isolated forest blocks by area-classes;
c) ownership of the woodland area;
d) number of owners by area-classes;
e) number of ownership-units by area-classes;
f) area, volume and increment by species, produce-classes (sawtimber, poles, pitprops, saplings, etc.) and diameter-classes;
g) distribution of the species by quality-classes;
h) method of establishment and the number of the generations;
i) composition of the soil-types in woodlands and waste lands;
j) area of woodlands and waste lands in each municipality.

The data about the roadside and other line plantations outside the forests will be given for the whole country. Therefore, the statistical method of inventory is quite different.

The census unit for woodlands is the stand, with a minimum area of 0.5 hectare (about 1 acre). The stands are reconnoitered on aerial photographs and afterwards visited in the field. Each stand is numbered and registered on ordnance maps 1:25,000 (about 2 ½ inches to a mile). The

area of the stands is measured on these maps. The timber volume of the stands older than 20 years is measured by random sample plots. A great number of sample plots with a radius of 8 meters (area 0.02 ha. or 0.05 acre) are fixed visually throughout the stand. In these plots the number of trees are counted to determine the mean number of trees per hectare. The mean arithmetic diameter is determined by measuring 60 to 100 trees at random throughout the stand. This mean diameter is reduced to the mean diameter corresponding with the mean basal area, in order to simplify the calculation. The mean height is found by measuring some trees with the mean diameter. The current increment of each stand is taken from yield tables. The soil type of the stand is determined with a soil borer.

NETHERLANDS: *A forest map of the Netherlands.*

1 – 8 *Forest regions*

– – – *Border of the forest region*

Forest area closed

Forest area scattered

As a great number of plots is measured, the results of this fast method of estimation are sufficiently accurate. Generally about 6 to 10 plots per hectare are measured at most. As in the Netherlands, stands have an average area of 1.5 hectares (4 acres), the average percentage of sampling is about 10 percent for the determination of the number of trees and about 5 percent for the determination of the mean diameter. This intensive method is carried out because the data for each stand are made available to forest owners as a basis for management plans.

On the other hand, the data about the roadside and line plantations outside the forests are determined by a mathematical statistical method, based on a 10 percent sampling at random of the whole country. The ordnance maps are divided into about 60 squares of 100 hectares (250 acres). On each map in one-tenth of the number of squares, chosen at random, the total length of the road plantation (single row) is measured. In the field the species, mean diameter, mean height and number of trees are determined. Based on this sampling method the census of roadside and line plantations outside the forests will consist of: species, length of the plantations, volume, diameter-classes, number of trees and ownership.

All data collected by the State Forest Service under the supervision of the Forestry Statistics Committee, are worked out by the I.B.M. system and published in co-operation with the Netherlands Central Bureau of Statistics.

Poland

• Poland has generously presented the United Kingdom through the Forestry Commission with a breeding pair of European bison. They arrived by air in October, from a reserve near Cracow, and were taken to the London Zoo for a period of quarantine. An official "handing over" ceremony took place later in November when the Polish Ambassador formally made the gift to the Chairman of the Forestry Commission. The animals are now on show to the public and may later be transferred to Whipsnade, a country zoo outside London.

European bison are rare forest animals and, until the arrival of the pair from Poland, the Zoological Society of London had none in its care. Poland has between 80 and 90 European bison, representing, it is understood, a substantial proportion of world stocks.

Sudan

• An article in *Sudan Silva*, a periodical published by the Sudan Forestry Society states that exploitation of the natural resources of the Sudan did not really begin until after the outbreak of war, for previously the Sudan had found it cheaper to import her supplies of timber. A sawmill was opened at Katire, some 3 ½ miles (5.5 km.) from the nearest forests. At the same time the difference in altitude, some 3,000 ft. (1,000 m.) between the two points, made logging and extraction very difficult. The operation was probably unique. From the felling site, in the early days, all operations were by manual labor. The logs were dragged to a road, and thence loaded onto a hand cart and taken to a timber slide which ran down to flatter country. Again a second timber slide was used ending in the sawmill log pond.

Recently an FAO technical assistance officer has been advising on modernization of sawmilling and of the Forests Department's timber operations. The Sudan's requirements in sawn timber are approximately 51,000 cubic meters per year. More than 75 percent of this quantity is imported and only less than 25 percent is produced locally. One quarter of the local production is from hand pit-sawing camps and three-quarters is produced by 11 semi-portable sawmills located mainly in the southern provinces. The policy is to reduce dependence on imports, by increasing local production near to the amount of annual growth of suitable species in the accessible forests. Labor-saving methods will be introduced in sawmills and some more suitable machinery acquired in order to increase efficiency and reduce production costs.

United Kingdom

• After the 1956 Congress of the International Union of Forest Research Organizations, noted in the last issue of *Unasylva*, a number of study tours were arranged to parts of England, Wales and Scotland. One of the tours covered south Scotland and the participants were specially impressed by the Forestry Commission forests in Dumfriesshire and by the Forest of Ae in particular. An article in the Edinburgh newspaper, *The Scotsman*, says of this forest:

"The actual planting of trees is only a very minor part of the work which goes on in a forest of the size and complexity of Ae. A skilled pieceworker will plant 2,000 trees in a day and the whole of the 1,209 acres planting of 1954 was carried out in nine weeks, and in the last week of March no less than 343,000 plants were planted! While it may not be quite so easy as it sounds, and does in fact call for a high standard of organization in the forest to ensure that the right numbers of the right species of trees are ready in the right places at the right times, it is true to say that the main concern of the staff during the planting season is not tree planting but fire. The planting season runs usually from late

February until early May and it coincides with the period of greatest fire danger. The dominant grass on Forest of Ae, as on most of the Border hills, is Molinia or purple moor grass, or, more significantly, ' blow ' grass. An east wind in early spring can change the accumulation of sodden dead grass left after the winter into a mass of highly inflammable material in a matter of hours. Under such conditions a smoldering cigarette is ample to start a fire which can devour the forest at the rate of an acre every five seconds! This was the rate at which the last big fire at Kielder burned 800 acres (324 ha.) of woods, travelling across the country as fast as a man could run. Perhaps the forester can be excused if he views the stranger within the gates with the gravest misgivings and suspicions on any dry day during these months, although at other times he is delighted to have visitors to his forest.

With the rush of the planting season past, summer sees the men on a variety of jobs, mainly in the older parts of the forest. Here there are fresh problems. It is one thing to grow trees and quite another to deliver them profitably to the consumer At Ae, the felled trees are trimmed up and stacked in lanes from where they are taken by horse-drawn " sulky " to the nearest forest road.

It is anticipated that eventually over 100 miles (160 km.) of these forest roads will be required at Ae, of which 20 miles (32 km.) have already been constructed. The method of construction is a matter of some interest. They are now made by the simple process of dumping gravel straight on to the natural surface of the ground, levelling being confined to places which are very uneven. The gravel is obtained from the bed of the river where a mechanical digger loads the lorries and at the same time trains the rather unruly Water of Ae. The lorries carrying the gravel to the " road head " themselves act as road rollers. When soft parts begin to sink they are filled up with the help of a light grader towed behind a wheeled tractor. By this simple technique a road capable of carrying 10-ton loads of timber is soon developed, and the cost of construction has been cut to a fraction of that required for construction along traditional Macadamized lines, while maintenance, which will also be done almost entirely by machine, will also be cheaper.

Since the oldest trees at Ae are only 27 years of age and therefore not nearly mature, the whole production from the forest comes from the gradual process of thinning the plantations. Thinnings are made in each crop from the age of about 20 years onwards, at intervals of three or more years. The selection of trees to be removed is a skilled operation, the aim being to get rid of the poorly shaped, unhealthy trees whilst encouraging the most vigorous and finest stems by giving them more growing space. Perhaps there is a moral in the fact that most of the marking at Forest of Ae is done not by two foresters but by a worker and his wife who live in the Ae Village.

Although upwards of 30 men still travel daily by lorry from the nearest big town to work at Ae, the human population of the forest, like its tree crop, has been growing steadily and now stands at a total of 164, including no less than 74 children —

SUDAN: *The photograph shows a French C.D. portable band sawmill cutting railway sleepers in the Equatoria Province.*

TURKEY: *The FAO officer advising on silviculture and management sends this photograph of natural beech and fir forest where he recommends introducing similar management methods to those practised in Switzerland. Clearings in the forest are invaded by* Rhododendron flavum *which presents difficulties in securing natural regeneration. Eradication is troublesome and expensive. The introduction first of poplar and pine seems necessary to suppress the rhododendron, after which the beech and fir return.*

Photograph: F. Zednik

a goodly number. Most of the population live in the Ae Village, which had the distinction of being the first entirely new village to be built in Scotland to house forestry workers. Thirty houses are now occupied and a further eight ready for occupation, with a shop and post office. With these tenanted it seems possible that the forest population may soon top the 200 mark."

• Educational Productions Ltd. have issued a new series of wall charts dealing with woodworking activities as follows:

1. planing
2. sawing
3. chiselling
4. stopped housing
5. mortice and tenon joint
6. dovetailing
7. shaping
8. veneering
9. cramping
10. wood finishing

Each chart gives detailed instructions for making a small item of equipment and is ideal for an instructor to hand out to a class as work sheets.

United States of America

• The Oregon State Board of Forestry has made available for licensing a patented process developed at the State Forest Products Laboratory to extract waxes, tannins and fine chemicals from the barks of native timber trees. So far no license has been issued, but the process is believed capable of providing a basis for a new industry in the northwestern United States.

• Under the widely discussed Soil Bank Program of the U.S.A. Agricultural Act of 1956, the Forest Service is authorized to obligate $4.7 million for the tree planting phase of the Soil Bank Conservation Reserve Program. Under this program, the Secretary of Agriculture is authorized to enter into contracts with producers for periods of 3 to 15 years under which the producer would devote a designated part of his cropland to conservation uses. The Secretary is authorized to pay a fair share of the costs of establishing the conservation use and to make an annual payment which will provide a fair and reasonable return for the land diverted from agriculture to conservation use.

Of the total allotment, $4 million is for nursery expansion, and the balance for Forest Service administration and technical services to be furnished by the State Foresters.

A separate unit has been set up in the head office of the Forest Service to deal with the responsibilities thus imposed.

• Inventors and U.S. Forest Service operators have been busy working on what is variously known as the "mechanical mule" and the mechanical trail packer, and at least a half dozen forms of the machine, designed to transport loads over narrow trails, have been devised and are being tested.

Among the uses already demonstrated are carrying the stores of firewatchers in and out of their lookout stations; transporting equipment for trail construction and maintenance crews; pulling out small stumps on trail construction jobs; modifying the packer into a trail compressor unit to drill holes for blasting; hauling a trail kitchen; and hauling a trail grader. The most recent development is to use the packer to retrieve smoke jumper equipment by breaking the machine into two parts which can be parachuted down and reassembled on the ground. Smoke jumpers are traditionally sent to inaccessible fires and carry in with them substantial loads; to backpack out the valuable equipment after fire control is a time-consuming and arduous task, and the mechanical conveyance will be a great asset in the whole program.

• A publication of the U.S. Department of Agriculture deals with the diseases of North American forest trees planted abroad, based on a re-examination of more than 3,000 articles and books. The publication first lists and describes the effects and the occurrence of the diseases, subdivided into the viruses, the bacteria, the fungi and the mistletoes. Next it lists the hosts of the diseases, giving for each forest tree the diseases known to attack. Then there is a general and, in part, detailed listing of the locations in other countries where each American forest tree is planted. In some cases, only the general location can be given, in more instances the exact location. A separate list, arranged by countries, gives specific locations of forest plantings of North American trees.

This publication brings the available knowledge up to date. Additional publications planned in the series are, first, a listing of North American plant pathogens known to attack foreign tree species growing in the U.S.A. and, second, a listing of the foreign infectious tree diseases, the damage they do, and the potential menace to North American forests of diseases not now known in North America.

The items appearing here are condensed from newsworthy material collected by FAO staff or submitted by correspondents. FAO assumes no responsibility for statements and statistics in items accepted in good faith from contributors.

Book Notices

Silviculture. J. Köstler. Transl. by M. L. Anderson. Oliver and Boyd. 1956. Edinburgh. pp. 416. 45s.

This is the first English edition of *Waldbau*, which was noticed in *Unasylva*, Vol. 10, No. 3. Following a brief introduction of silviculture's position in forestry as a science, the role of the prescribed cut, the importance of stand diagnoses, and the possibilities of silvicultural treatment, the author discusses most absorbingly the concept of the forest as a living community, and silvicultural treatment as interference with such living communities.

As a text book, this English edition gives much of value for forestry students in the chapters on forests as vegetation types, genetics, the effect of environment, life processes and forest sociology. The discussion of forest types and associations is instructive. The brief chapter on man as an environmental factor is thought-provoking.

The second part of the book is a clear presentation of selection forests, tending operations, and regeneration problems and methods. The concluding chapter on the biologically managed forest is worthy of careful reading not only by students but by practising silviculturists as well.

The Form and Taper of Forest-Tree Stems. H. R. Gray. Imperial Forestry Institute. 1956. Oxford. pp. 78. 12s.6d.

Tree *form* is usually taken as an indication of the potential recovery of good quality timber from a forest-tree stem. Various efforts have been made to express mathematically the *form* or shape of trees. *Taper* of a given *form* or shape of stem is the rate of narrowing of diameter from the base toward the small end. Thus there can be cone, paraboloid, or cubic paraboloid forms, each with a high, medium or low taper. It is possible to compute *form factors* which are functions of the underbark volume of the stem, the overbark sectional area at breast height, and height of stem. Such factors are useful in computing the usable volumes which can be expected from stems of various shapes and dimensions.

In this presentation of an obviously complex subject, the author compares various theories of stem form, the factors that influence this form, as a basis for application of theoretical considerations in computing volumes and measuring standing trees.

For those with specialized interest in this phase of forest mensuration, Mr. Gray's thesis will be of value.

Shifting Cultivation in Africa (The Zande System of Agriculture). P. de Schlippe, pp. 304. Illus. Routledge and Kegan Paul, Carter Lane, London, E.C.4. 42s.

Studies on the vexed question of shifting cultivation are few. An FAO Development Paper, recently issued, gave two case histories relating to Africa. This very interesting book offers a third.

The author has carefully studied the way of life and customs of the Azande people whose economy is based on agriculture. He shows how the problems of shifting cultivation cannot be understood or solved except by also studying social anthropology.

The Azande territory lies between the frontiers of the Sudan, the Belgian Congo and French Equatorial Africa. In the Sudan, between 1946 and 1950, a project known as the Zande scheme resettled the families of about 60,000 cultivators on individual plots consisting of long strips of 800 to 1,000 meters long and 150 meters wide, divided into a certain number of villages composed of 50 to 60 holdings. The scheme was based on the introduction of the cotton industry into the country and, from the industrial point of view, is a great success. But industry on its own was only supposed to employ 2 percent of the population and the rural population was affected by the social aspect of the scheme. With industrial development came roads, dispensaries, schools, shops and training centers. The weak point is the fact that cotton growing is not yet " integrated " into the Zande agricultural system.

The author restricts himself, in this first volume, to an analysis but it is sufficient to show the dangers of a system of shifting cultivation by a rapidly growing population, primarily the progressive degradation of the soil. The author considers the problem as an agricultural one. However, one assumes that the forest itself could play a much more important part in furnishing a livelihood for these people; up to now this has been impossible owing to lack of outlet for its products, forest industries and means of communication.

A second book is promised by the author in which he proposes solutions to the problems studied here.

Genetics in Silviculture. C. Syrach Larsen. Transl. by M. L. Anderson. Oliver and Boyd. 1956. Edinburgh. pp. 224. 30s.

Seeking to impress on foresters, forest owners, and all who have interest in living trees, the importance of genetics in forestry, the author emphasizes the great influence of inherited characteristics on tree growth. There are very readable chapters on aims and possibilities of genetics work in general, on a historical review of the subject, progeny trials, controlled pollination, vegetative propagation, seed-gardens, special genetics arboreta or " tree-shows ", breeding and disease hybrids, and special discussions of breeding of larch, and a simplified presentation of the principles of genetics. The final chapter is a philosophical plea for keeping pace with technological development in mechanization of agriculture and forestry by taking advantage of the potentialities of genetic principles and methods in the development of silviculture.

This book deserves widespread attention among foresters, as another reminder of what genetics research can accomplish if properly supported.

Forest and Range Policy: its Development in the United States. Samuel Trask Dana. McGraw-Hill Book Co., Inc., New York. 1956. U.S. $6.50.

" Policy ", says the dictionary, is " a settled or definite course or method adapted and followed by a government, institution, body or individual. " Thus, says the author, a single forest, range and natural resource policy for an entire country is possible only when the central government has complete authority to dictate to both public and private agencies. The other extreme has been found in the United States where many government units and private individuals have set their own policies and courses. This excellent book, then, treats policy in the broadest, rather than in a narrowly technical, sense, indeed as a major manifestation of the evolution of American government, institutions and life.

The history begins in early colonial times when, in 1626, Plymouth Colony forbade the selling or transportation of timber out of the colony without the approval of governor and council, and continues to the present. To cover so long a period, a major problem is to organize and arrange the vast and complex material. The author has solved his problem by a primarily chronological treatment, but adopting subject matter grouping within each chapter.

The chapter titles indicate the main stages. They are: colonists, kings and forests, ending with establishment of the United States of America in 1789; acquisition and disposal of the public domain; exploitation of timber and forage, which long went along with the freehanded disposals; forestry in the offing, the early challenges to exploitation; forest reserves arrive, 1891, and finally are put under some form of administration in 1897; prelude to progress, the accelerating pace leading to transfer of the reserves to the U.S. Department of Agriculture in 1905; forestry in practice and politics, the dynamic early years of the Forest Service under Gifford Pinchot; new approaches, the troubled but productive years from 1911 to the end of the first world war; controversy and co-operation, from the first fight for regulation of private cutting to the New Deal of President Franklin Roosevelt; conservation under the New Deal, in the main a new and powerful surge of advances, with belated attention to the vast public ranges; and forestry comes of age, with strengthened state and private forestry, and further expansion of the role and activities of the National Government which, during most of the long history, was the dominant leader. Finally, there is a summary and analysis, in which are treated origins, status and remaining issues in Federal, State and private forest policies dealing with ownership, cooperation, regulation, research and education.

Supplementing the text are:

1. A survey of federal policy on wildlife, soil, water and minerals. This is valuable because of the often close relation of forest and range policy and of policies regarding the other resources.
2. A chronological summary of important events in the development of colonial and federal policies relating to natural resources. This valuable section is comprehensive indeed, and summarizes concisely each event.
3. A selected bibliography.
4. An admirably complete index.

Into this scholarly and comprehensive work have gone not only vast labor, but the seasoned and mature judgment of a senior forester, who has participated in much of the history of the highly significant last half century. His judgment of significance, of probable or possible future direction, of relative stability of different forms of ownership and of the relative force of the several components in the current scene may be argued and challenged. But his conscientious objectivity will hardly be doubted.

During the past thirty-five years there have been several other very good books on American forest policy, only the last of which (Greeley, 1953) was by a professional forester. Each has its own point of view and emphasis, sometimes overemphasis. Dana's book has, of course, drawn on them. But it supplements rather than supplants them. It covers a broader field. It is more widely comprehensive. It is better balanced in scope of treatment of events and forces. Above all, it brings things up to date.

This is not only a textbook. It is a much needed work of reference. It draws the picture for the layman as well as for the professional. It puts under one cover a truly significant and vastly important segment of American history. Thus it merits attention outside the United States by those who see in historical analysis something more than the mere record of events.

Hout In Alle Tijden (Wood Through the Ages). Volume V. ***Chemische en Mechanische Hout-technologie.*** (Chemical and Mechanical Wood Technology). W. Boerhave Beekman. pp. 619, illus. A. E. Kluwer, Deventer 1956. Fl. 47-50.

The Director of the Wood Academy of the Netherlands, in collaboration with many experts, compiled in this book the latest methods used in the mechanical and chemical woodworking industries. As an introduction to both sectors, the physical and chemical properties of the different tree species are described. In fourteen sections are described the modern techniques used for processing charcoal, pulp, wood sugar, tannin, resin, gum, oil, dyeing material, sawnwood, veneers, plywood, fibreboard and particle board.

The manufacture of the different commodities derived from forest products is described in a way that even the non-technician may follow. For a reader who wants more details, an extensive bibliography is attached to each chapter, and there are carefully prepared indexes at the end of the book.

Houtteelt der Gematigde Luchtstreek. (Silviculture of Temperate Zones). Volume II - ***Het Bos*** (The Forest). G. Houtzagers, pp. 438, illus. W. E. J. Tjeenk Willink, Zwolle 1956. Fl. 41.

The first volume of this standard work, written by a professor of the Agricultural University in Wageningen and dealing with individual forest species, appeared in 1954. This second volume deals with the forest as an entity. Both volumes are more than students' textbooks, in fact they constitute a compendium of more than a thousand pages for forest owners and technicians.

The first part of the new volume deals with silvics and starts with a brief discussion of the efforts made to classify the world's forests. An important section follows on the different factors influencing a forest association: temperature, light-requirements, wind, physical and chemical properties of the soil as well as the biotic factors are dealt with, on the basis of the latest English, French German and Dutch literature on the subject.

The second part deals with applied silvics, the different sections being very well illustrated. A first section describes the problems involved in the creation of new forests, including the use of heavy equipment for soil preparation and planting, and is followed by a discussion of the different thinning methods used in North America and Europe. It ends with a description of the classic silvicultural systems such as clear cutting, shelterwood system, selection system, etc.

The third part deals with plant formations and forest types of North America, Europe and the Soviet Union and ends with a short history of forestry and forest policy in the Netherlands.

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Yearbook of Forest Products Statistics
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Prepared by the Forestry Division of the Food and Agriculture Organization of the United Nations, the tenth *Yearbook of Forest Products Statistics* includes information from more than 120 countries for 1955, with revisions made in 1954 figures as available. The publication carries world production tables, technical notes, country notes and a leading chapter entitled " Salient Features of the World Situation, 1955 ".

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This paper is one of the geographical sections of the *World Planting Manual*, and deals with the seed, nursery and planting practices in the tropical zone of Africa. 1956, 302 pp. In preparation.

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